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TREATISE
ON THE
STRUCTURE, ECONOMY, AND DISEASES
OF THE
LIVER:
TOGETHER WITH
AN INQUIRY INTO THE PROPERTIES AND
COMPONENT PARTS
OF THE
BILE AND BILARY CONCRETIONS.

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WALPOLE, N. H. / 2646

PUBLISHED FOR WILLIAM FESSENDEN, BOOKSELLER,
BRATTLEBOROUGH, VT. BY CHEEVER FELCH.

1810.



P R E F A C E.

THE former edition of the following sheets has met with a sale which far exceeded the Authour's expectations. The respectful notice which has been taken of the work, by gentlemen of the first rank in the profession, and whose approbation and esteem he must ever be proud to acknowledge, together with the favourable manner in which it has been received in the various critical periodical publications, have induced him to extend his enquiries and observations upon the subject still farther, and to prepare a second edition for the press.

The attention which his book has excited, has been the occasion of his being frequently consulted, and of bringing many cases under his review, which have

enabled him to extend his practical observations, and to observe the variety of symptoms which occur in the different stages of those diseases in which the Liver is the organ chiefly affected.

Indeed, so general is the influence of the different functions of this viscus, that any derangement of them may be expected to have considerable effect on various other organs. Probably many complaints, which the patient is ready to refer to the organs of respiration, to the stomach, or other parts of the alimentary canal, may have their source in a morbid state of this organ.

The accumulation of bile in the liver and gall-bladder, producing a turgescent state of that organ, and perhaps occasioning a congestion in the large blood-vessels of the abdomen, may be the frequent cause of that species of apoplexy which is best cured by purgatives, and such other means as promote the evacuation of bile. It is probable, likewise, that the good effects perceived from the operation of active purgatives in the early stages of acute diseases, and the advantages arising from spontaneous or even artificial diarrhoea in the more advanced stages of them, chiefly depend on the hepatick system being kept pervious, so frequently the seat of dangerous fevers. Some affections of the mind, it is also probable, may be intimately connected with such a state of the Liver.

Not only by his own observation, but also by the correspondence which he has had with gentlemen of

the profession, who have seen the hepatitis in the East-Indies, he is more fully confirmed in the propriety of the treatment he has recommended in the first stage of that disease. He must still, therefore, consider the antiphlogistick practice, there specified, as the most likely to succeed ; and with all his partiality for the use of mercury, in the more advanced stages of the disease, and even before the inflammatory symptoms have subsided, he thinks that too early an application of it has been attended with disagreeable effects.

That he possesses no prejudices against this important article of the *Materia Medica*, will appear clearly, when the reader discovers the attention he has paid to the different modes of exhibiting it in some diseases arising from an affection of this organ. In a state of the liver, approaching to *schirrus*, he considers it as the only medicine to be depended upon ; and more than this, in other diseases such as diarrhoea and dysentery, which he considers as having a frequent reference to such a state of the organ, he has experienced considerable advantage from the use of it.

Being consulted by many patients labouring under ascites, and other species of dropsy, he has frequently been able to trace the source of these diseases to some morbid state of the liver. The Authour has, therefore, improved this edition, by giving some explanation on the general pathology of dropsy, more especially, however, as depending on the resistance to the

transmission of blood through the venous system of the liver ; he has likewise extended his inquiries on the subject of diet, and the probable influence of the hepatick system on the process of digestion.

He cannot conclude this Preface without acknowledging the obligations he has to Dr. HAIGHTON, Lecturer on Physiology and Midwifery at Guy's Hospital, for the ingenuity and accuracy with which he has planned and executed the various experiments made on brute animals for the purposes of explaining and corroborating the doctrines advanced in this treatise.

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CHAPTER I.

ANATOMICAL DESCRIPTION OF THE LIVER.

SECT. I. TO the secretion of the bile nature has destined an organ of considerable size, called the Liver; its magnitude is greater than that of any gland in the body, so that it occupies a very considerable part of the abdominal cavity.

2. Its figure is somewhat irregular, consequently it does not readily admit of comparison with any mathematical figure; it is unlike any body with which we are acquainted. This circumstance of the liver is perhaps less essential than may others, as figure does not appear to throw any light on its economy. At least we naturally incline to this opinion, from taking a view of this viscus in different ani-

mals, when it appears that the external figure of the liver is determined by the figure of the animal itself, or that particular cavity in which it is contained. In the human subject it is somewhat flattish and convex on its anterious surface, irregular on its posterious, having several depressions; at its inferious edge there is a fissure extending some way up, particularly on its posterious surface, which forms a division into two lobes of unequal sizes. These, from their situation in the abdominal cavity, are distinguished by the names of right and left, of which the right is the larger. Besides these, there is a smaller lobe, situated at the superious and posterious part, called *Lobulus Spigelii.*

3. Though in adult subjects the right lobe is larger than the left, in the fœtus the left is as large as the right. This variety depends on the disposition of the umbilical vein in the fœtus with respect to this organ; for on its arrival at that gland, it sends off several branches, some of which, penetrating the left lobe, are of considerable size; but after birth, when the circulation takes a new course, the whole liver, but more especially the left lobe, diminishes in bulk.

4. Besides this variety in the proportion of its lobes, the whole fœtal liver must necessarily exceed that of the adult in proportion; for, in addition to the vessels proper to the liver, and necessary to its economy, there is one peculiar to the fœtus, viz. the umbilical vein. This vessel, which has its origin in

the placenta, accompanies the other vessels of the cord, and perforates the navel ; thence, having reached the inferior edge of the liver, it passes along the fissure which separates the lobes, and, having entered its substance, sends off several branches ; those going to the left lobe are larger and more in number than those to the right. After which the umbilical vein divides into two branches, one taking the course of the vena cava, called canalis venosus ; the other, uniting with the branch of the vena portarum, pours its blood into that system ; so that by much the largest proportion of the blood circulating between the fœtus and the placenta passes through the liver, and this sufficiently explains why the fœtal liver exceeds in proportion that of the adult.

5. This organ is situated in the superior part of the abdomen, principally on the right side, occupies the epigastric and the right hypochondriac regions, and sometimes extends into the left hypochondre. Its precise situation cannot be easily determined, as the inferior part of the chest admits of considerable variety both in its figure and capacity. In males, where there is a greater capacity of chest, the hypochondres are more capacious, hence the epigastric and the right hypochondriac regions are large enough to contain this viscus.

6. In females, who have naturally a smaller chest, which is still more contracted by tight lacing, the epi-

gastrick and the right hypochondrick regions are insufficient to contain the liver, it therefore extends far into the left hypochondre ; besides which, it sometimes, in these cases, occupies no inconsiderable part of the umbilical region. Its situation, then, with respect to the general cavity of the abdomen, admits of some variety. In the fœtus, it occupies the whole epigastrick region, and both the hypochondres ; not so much from any peculiarity in the figure of the upper part of the abdomen, as from a difference in the proportion of the right and left lobe, which has already been noticed.

7. Though the situation and extent of the liver, in the general cavity of the abdomen, admit of some variety, yet its position with respect to the diaphragm is rather precise, being connected to it by doublings of the peritonæum, called ligaments.

8. This viscus, in common with the others of this cavity, receives a covering from the peritonæum, which, doubling upon itself, and quitting the liver, is attached to the diaphragm. This connection obtaining in certain parts, forms the ligaments. The most conspicuous of which, is that situated on its anterior part, in a line corresponding to the fissure, forming the distinction between the right and left lobe, which, extending from the superiour to the inferiour edge, is called by some, from its resemblance to

a scythe, the FALCIFORM ligament; by others, from its function, the SUSPENSORY ligament.

9. The lateral portions of the liver are connected in like manner to the corresponding parts of the diaphragm, taking the name of lateral ligaments. Besides which, some anatomists reckon the portion of peritonæum surrounding the vessels, which pass from this viscus through the diaphragm, as a fourth ligament, and call it the coronary ligament.

By these different reflections of the peritonæum, the liver is supported in its situation.

10. But there is yet another part, usually numbered with the ligaments, which, however, performs no ligamentary function, viz. the ligamentum rotundum.* This passes from the concave part of the liver along its longitudinal fissure, and is continued to the umbilicus.

11. Hence in the living subject the situation of the liver must vary with respect to the general cavity, according as the diaphragm descends or ascends, in the acts of inspiration or expiration.

12. The situation of the stomach with respect to

* The ligamentum rotundum has already been noticed under the name of umbilical vein, of which it is to be considered as the collapsed remains: for after the circulation through it, has ceased, which necessarily happens at birth, its cavity diminishes, and in time becomes nearly obliterated.

this organ is such, that the right portion of the former is frequently covered by the left lobe of the latter, and, from the billious tinge frequently found on the external surface of the duodenum near the pylorus, it appears that the gall-bladder usually rests on this part.

13. The gall-bladder is a bag somewhat pyriform in its shape, its neck or small extremity being situated superiorly, and its fundus, or large extremity, inferiorly. It is lodged in a depression on the concave surface of the right lobe of the liver, to which it is attached by a continuation of the peritoneal coat of that viscus over its surface. It varies somewhat in size according to the degree of distention which it suffers, but, in most instances, the fundus projects a small distance below the inferior edge of the liver. Destined by nature to contain bile, it has a duct which both receives and discharges it, the economy of which will be considered hereafter.

CHAPTER II.

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VESSELS OF THE LIVER.

Sec. 1. Every organ destined by Nature to secrete a fluid, is very plentifully furnished with blood. The necessity of this is evident ; for it requires, not only a supply of that fluid for the purpose of its nourishment, but an additional quantity also to enable it to perform its secretory functions ; as it is from the blood that all the secretions are derived.

Such is the economy of Nature in glandular bodies in general, that the same fluid which is fit for the nourishment of the gland, is adapted also to its secretory office, and is conveyed to the organ by the same vessel. But the physiologist is unable to ascertain, with any degree of precision, how much blood is allotted to nutrition, and how much to secretion.

2. Our knowledge of the economy of Nature in this respect, receives some light from a peculiarity which obtains in the liver, and which distinguishes it in a very striking manner from all the other glands in the body. For while the functions of nutrition and secretion are in them combined in the same vessel, in this, these offices are kept apart, and performed by

different vessels. Therefore, by a judicious comparison of the area of the nutriment with that of the secreting vessel, we may readily allot to each its due proportion.—But this idea will be farther pursued hereafter.

3. Blood of every description is not equally fit for nutrition, that only, which has received the change from the respiration, and which circulates through the arteries, is well adapted to this purpose; therefore the liver receives its nutrimental blood from an artery.

4. The rule which seems to guide the conduct of Nature in the origin of vessels supplying other organs, obtains equally in this, as the hepatic artery arises from the nearest considerable trunk.—The following is the mode of its origin:

5. The Aorta, while it is passing between the crura of the diaphragm, sends off, from its anterious part, three considerable azygous trunks: the first takes the name of cœliack artery; the second, which is almost immediately under the former, is called the superior mesenterick; and the third, going off from the aorta at some distance from the last vessel, is named the inferior mesenterick artery: the two last supply the intestinal canal.

6. The cœliack trunk soon divides into three branches — the first, being distributed to the lesser curvature of the stomach, is the coronary artery; the second, passing to the left, is called the splenick ar-

tery ; and the third, or largest, whose office we are now to consider, takes the name of the hepatick artery.

7. The hepatick artery, at its origin, is a vessel of considerable size, but before it arrives at the liver is sensibly smaller ; the cause of which is, that in its progress it supplies adjacent parts with blood, viz. the right portion of the stomach by means of the gastrica dextra and pylorica, and the gall bladder by the arteria cystica ; therefore in forming a true estimate of the quantity of blood sent to the liver for its nourishment, we are to consider the area of the hepatick artery, after the three preceding branches are sent off.

8. This vessel, agreeably to the general law of distribution, divides into branches before it enters the substance of the liver ; its ramifications then multiply and extend with great minuteness through the whole mass ; so that in every part of its substance there is circulating blood possessed of properties fit for nutrition. But as this blood is in a state of constant motion, and is continually changing by successive supplies, a redundancy is prevented here, as well as in other parts of the body, by returning veins. The ultimate branches then of the hepatick artery terminate in the hepatick veins, and these return the blood into the vena cava inferiour, by three or four venous trunks. Such is the circulation through the liver as connected with its nourishment. We are next to consider it as an organ of secretion.

9. This organ differs from every other gland of the body with regard to the nature of the blood from which secretion is performed. While other fluids are secreted from florid arterial blood, which has lately received changes from the air by the intervention of the lungs, the bile is formed from blood of a darker colour, possessing the common characters of venous blood, and is conveyed to the liver by a vein.

10. The vena portarum, which conveys this blood, takes its name from the part of the liver at which it enters ; there being two eminences, one on each side of the fissure, called the portæ, where this vessel begins to penetrate. To understand the origin of the vena portarum, and the properties of the blood which it conveys, it will be necessary to explain the circulation through the chylopoietick organs. The branches of the cœliack and mesenterick arteries, as we have before observed, distribute their contents to the stomach, intestines, pancreas, and spleen, besides the hepatick artery which supplies the liver. The blood circulating through all these viscera, except the last, being returned by their respective veins, is poured into their common trunk, the vena portarum : thus the origin of the vena portarum appears to consist in the concurrence of all the veins of the peritonæal viscera, except the liver.

11. As the function of this vein differs from that of other organs, it has been supposed to possess some

peculiarities of structure.—Some have thought it more muscular than other veins, and that its characters approach nearer to those of an artery. It certainly does not possess the grand discriminating mark of an artery, or the power of preserving its orifice circular when divided transversely. If it differs from veins in general, it is in having thicker tunicks in proportion to the capacity of its canal ; but with respect to the arrangement and disposition of its muscular fibres, this part of its structure does not appear sufficiently defined to authorize us to speak with precision.

12. **GLISSON**, whose opinion on this subject is not always quoted with approbation, conceived its grand characteristick to consist in a continuation of that duplicature of the peritonæum surrounding the vessels going to the liver, in a manner of a capsula, and to which it is usual to annex his name.

He conceived, likewise, that it not only envelopes the trunk of this vein, but accompanies it in all its ramifications through the liver ; so that if a section were made into this organ, the branches of the vena portarum would be distinguished from those of other vessels by the presence of this adventitious tunick.

13. For this mémbrane, which the imagination had formed, fancy soon suggested a use—Mistaken observation had led him to believe that it possessed muscular properties, and that it propelled with force the blood, whose motion would otherwise have been

languid. The investigations of other anatomists have not confirmed this opinion. They have disproved the continuation of this peritonæal capsula beyond the trunk of the vena portarum, and have demonstrated that it does not envelop the vena portarum in a particular manner, but only invests it in common with other vessels, and as soon as it has arrived at the liver it quits them altogether, and, by expanding itself over the substance of this gland, forms its tunick.

14. The vena potarum having reached the liver at that part called the great fissure, forms one large trunk called the sinus of the vena portarum, from which three principal branches usually take their origin; these, by forming subordinate ramifications in a regular series, at length arrive at their terminations.

15. The extremities of these vessels end in two ways : one with respect to the circulation of the blood ; the other, as connected with their economy, as secreting vessels. In the first point of view they insculete with branches of hepatick veins, and through that channel return to the inferiour cava all that blood which is not employed in the business of secretion. So that the hepatick veins are the common recipients of the contents of the hepatick ducts, called pori biliarii ; which in their origin must necessarily be very minute, inasmuch as they preclude admission of the red particles of the blood : from these minute beginnings they gradually enlarge by an union of branches, until at length they pass out from the liver at its fissure,

by two or three trunks, which soon after join together, and form the trunk of the hepatic duct.

17. The structure of this vessel is apparently membranous, having no fibres which can be considered as muscular, at least as far as we can decide by ocular demonstration. But, as the eye, even when aided by glasses, is not always competent to detect muscularity, we are compelled to have recourse to another and less fallacious test, which is the power of contraction on the application of a stimulus. Mechanical and chymical stimuli have been applied to this duct in a living animal, without producing any contraction which can be referred to muscularity. Some chymical stimuli, it is true, will corrugate this canal : but they are such as produce effects only by corrosion, and which they do as readily on inanimate as on living matter.

18. Another argument against their muscularity is, that canals obviously muscular, readily adapt their capacity to their contents. This law is very evident in the vascular system. But when a biliary duct has been dilated by the passage of a gall stone, it does not very soon return to its primitive dimensions. And perhaps, those painful affections of these parts, which have been very commonly considered spasmodick, may find a more adequate explanation in the passage of a calculus.

19. If the internal surface of this system of vessels be examined, it will be found moderately vascu-

lar, as there is an appearance of follicles in many parts ; hence it is probable, that it secretes a mucous kind of fluid.

20. Besides the vessels already described, the liver is very plentifully supplied with absorbents, which take their origin from every part of its substance, but more especially from the branches of the hepatic duct. The proof of this origin will be found reserved until we treat of the economy of this organ. From the interior part, the absorbents pursue the direction of the surface, some ramifying on the anterior and some on the posterior surface : their disposition while on these parts is arborescent. Those on the convex surface incline towards the direction of the falciform ligament upon which they pass, and extending their course in the direction of the diaphragm, terminate in the thoracick duct near to that part. Those which ramify on the concave surface, form, by a series of junctions, a common trunk, which, passing from the liver in the direction of the hepatic artery, and with it and the other vessels being inclosed in Glisson's capsula, terminate in the thoracick duct near the receptaculum chyli.

21. These two sets of absorbents while ramifying within the liver, have a free communication with each other, as may be proved by injection with mercury. From a superficial absorbent on the convex surface, mercury will sometimes penetrate the substance, and thence pervade those on the concave side, from which the thoracick duct may be filled.

22. These vessels possess the same character while in this organ as they do in other parts of the body ; that is to say, they are valvular. But notwithstanding this, they may be injected in a direction contrary to that in which their contents move. This, though apparently a paradox, is strictly consonant to reason and fact ; for the function of the valves here is less complete than in some other parts of this system, so that by pressure, mercury may take a retrograde course in the same vessel.—Another reason is, that as the lateral communicating vessels exceed the valves in number, a cluster of absorbents may be injected by a course in part retrograde, and in part circuitous. It is in this way an injection may be made to pass through the branches of the spermatick vein, in a direction contrary to the natural circulation ; yet those vessels are plentifully furnished with valves.

23. Besides vessels, the liver is furnished with nerves, though not very plentifully. The par vagum and intercostal nerves, while in the cavity of the thorax, communicate by branches with each other. Near to this part of junction several branches are sent off, some of which are distributed to parts contiguous, others to more distant organs. But there is detached from each side a branch more conspicuous than the others, viz. the splanchnick nerves, both of which having pierced the diaphragm, unite.

24. At the part of union there is formed a ganglion, which from its crescent-like figure, is called

semilunar. From this ganglion a multiplicity of nervous filaments are passing off in various directions, which intermixing and observing a radiated course, form the solar plexus. From this, several subordinate plexuses are detached, which receive names from the parts they supply; hence the names of stomachick plexus, splenick plexus, &c.—But from its right portion, several small nervous filaments pass, which, surrounding the hepatick artery, accompany it to the liver, and take the name of hepatick plexus.

CHAPTER III.

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THE NATURE OF THE BLOOD CIRCULATING THROUGH THE VENA PORTARUM CONSIDERED.

Sec. 1. HAVING given a general description of the vessels supplying the liver, we are led to examine into the nature of their contents. And here we may remark, that it is very desirable, but at the same time extremely difficult, to ascertain the peculiar characters of the blood, after circulating, through each of the chylopoietick viscera, previously to its passage into the liver, by the vena portarum ; and to determine why it seems better adapted to the secretion of bile than common arterial blood, from which other secretions are supplied.

2. That venous blood is more favourable to this secretion than arterial, is very evident ; this exception of the liver to Nature's law, in the economy of other glands, may be admitted as a proof. But the peculiar changes induced in the blood, after circulating through the arteries of the stomach, and yielding the gastrick fluid ; after penetrating the pancreas, and there affording pancreatick juice ; after pervading the intestines, where it not only gives out the intesti-

mal mucus, but from its vicinity to fæculent matter may receive putrescent properties, are at present, and may perhaps continue long to afford, an ample field of speculation and conjecture.

3. The power of the spleen in this respect has been particularly acknowledged and insisted upon ; insomuch that modern physiologists have considered this as its only function. That the spleen, in common with the other viscera, may contribute somewhat to change the properties of the circulating blood, ought not to be denied ; but whether this be the principal and only end of this function, I think, cannot be too carefully investigated.

4. The number and rank of those physiologists, who have considered the spleen as an auxiliary organ to the liver, are too respectable to be opposed on any ground, except that of experiment and induction.

When opinion is opposed to opinion, and no reasons adduced on either side in support of each, whatever difference there may happen to be in the credit or authority of their respective promulgators, the opinions themselves stand on equal ground. It is the reasons then which stamp the true value of any opinion, and to them only we shall direct our investigation.

5. First, "*The blood which has circulated through the spleen, and which is returned from that viscus by the splenic vein, is poured into the vena portarum.*"

6. The position is unquestionably true, and merits consideration ; yet its proper influence on the mind, when considered as proof, ought to be duly weighed ; for when we recollect that this circumstance in the spleen is not a peculiarity in that organ but one which obtains in every peritoneal *viscus*, except the liver, it must be evident, that, as far as this argument alone has force, the position falls infinitely short of proof, and that the spleen administers to the office of the liver only in the same proportion as the contiguous *viscera*. This idea then appears to owe its birth more to our ignorance of the real use of that organ, than to any force in the cause just assigned.

7. Secondly, “*The blood in its course through the spleen, receives chang’s which enable it the better to concur with the liver in the secretion of bile.*”

The changes ascribed are, a greater degree of fluidity, and a putrescent tendency.

8. Baron Haller was of opinion, that the blood returned by the epiploick and mesenterick veins contained a large portion of adipose matter, which it received by the absorbent power of those veins, and which imparted to it so great a degree of viscidity, that without the diluting power of the splenick blood, which mixes with it when entering the *vena portarum*, it would be liable to concrete.

9. There is little probability in this opinion, whether we consider the power of the epiploick veins to absorb fat from the *omentum*, or the function of the spleen to dilute the blood of the *vena portarum*.

Abortion by red veins has so few advocates in the present day, that it were superfluous to adduce either argument or experiment by way of refutation. But waving that controversy, let us enquire how far the spleen acting on its blood as a diluting organ, can be supported by facts.

EXPERIMENT.

10. The *abdomen* of a living dog being opened, and the spleen with its vessels being drawn gently out, blood was taken both from the artery and the vein, and received into cups of similar shape and equal size. On weighing each, there was found to be 420 grains of arterial, and 468 of venous blood. Both coagulated in less than two minutes, and in about the usual time they separated into *serum* and *erassamentum*. In twenty-four hours the *serum* of both was accurately weighed ; the 420 grains of blood from the splenick artery separated 191 grains of *serum*; the 468 grains from the vein, separated 213 grains.

11. But our conceptions of this matter will be much assisted by instituting a comparison with one common standard, still preserving the *ratio*.

Therefore we say, 1000 parts of blood from the splenick artery separated 454, while the same quantity from the vein yielded 455 ; a difference so inconsiderable as this, surely can never be laid hold of as a proof that the spleen is subservient to the liver, on the principle of a diluting organ.

But to pursue the inquiry still further, I thought it of importance to examine the fluidity of the serum.

EXPERIMENT.

12. Equal portions of each serum were exposed nearly to the same degree of heat, until coagulation had taken place. Upon pressing the surface of each, there exuded at different points small particles of a watery fluid, which Senac calls the serosity of the blood; and, upon examining the proportions of each, I could not discover any difference. Therefore, if we admit that the liver receives any assistance from the spleen, it does not appear to owe any thing to that organ on the principle of dilution.

13. The other change supposed to be induced in the blood by its circulation through the spleen, is a putrescent tendency; this has been conjectured in part from its contiguity to the *colon*, and in part from the languid state of the circulation through that *viscus*.

Without instituting any serious inquiries into the probable weight of these reasons, and their sufficiency to support the proposition, let us inquire into the fact itself.

EXPERIMENT.

14. Two portions of blood, one taken from the splenick artery, the other from the vein, were exposed for four hours to a heat upwards of 90 degrees; but

neither of them betrayed the smallest marks of putrefaction.

This opinion appears to have originated in an erroneous idea concerning the properties of the bile, which some have considered as the most putrescent fluid of the body ; but with extreme impropriety, as experiments have fully evinced.

15. Thus far our inquiries have favoured very little the connection between the spleen and the liver. But in order that the refutation may be more complete, it is necessary that a comparison be made between bile taken from an animal whose spleen has been previously removed, and one in which that *viscus* is still remaining.

EXPERIMENT.

16. The spleen of a dog was removed, and the wound healed up in a few days. He was kept several weeks afterwards, during which time he ran about the house like any other dog. Another dog in perfect health being procured, both were strangled, and the bile contained in the gall bladder of each collected in separate vessels for the purpose of comparison.

17. The colour of both, which was that of a bottle green, corresponded very exactly.

There was no difference in tenacity ; in both it was just sufficient to prevent its falling from a phial in drops.

The taste of each was intensely bitter, and slightly pungent.

No perceptible difference in smell.

Portions of each being mixed with *litmus*, turmeric, and syrup of violets, betrayed no difference of colour..

Equal portions of each of these specimens of bile, being mixed with equal portions of concentrated vitriolick acid, a brown colour was procured ; and with a very diluted vitriolick acid, a straw colour.

With concentrated nitrous acid, both effervesced, and exhibited a brown colour.

With alkohol there was a flocculent appearance. Evaporation to a thick extract left a *residuum*; which was highly inflammable.

18. The result of these experiments makes it highly probable, that the bile secreted after the loss of the spleen, differs in no respect from other bile ; and that the liver in the exercise of its function is perfectly independent on that viscus.

19. Thus we see that an opinion, which has received a degree of currency from the sanction of men of eminence, loses its importance, when examined by the test of experiment ; and a patient investigation of Nature's operation, on this plan, must ever prevail over authority or prejudice.

20. It has been proved above, that venous blood is the proper source of the bilary secretion. Some assert, that some additional properties are imparted to it during its circulation through the peritonæal viscera ; but neither experiment nor observation has

contributed any thing conclusive in favour of such opinion.

21. The peculiar economy of the biliary organ in the *fetus*, is particularly deserving our consideration, as the blood from which the secreted fluid is made, cannot be considered as strictly venous, but as partaking in some measure, of the arterial character; and this intermediate condition of Blood appears to produce a correspondent state of the bile; for it is matter of notoriety that foetal bile is less active and concentrated and abounds more in the watery principle, than that of the adult. This being granted, it necessarily follows, that whatever changes are induced in the blood in passing from the arterial to the venous condition, those changes furnish the principles which adapt the blood more completely to this purpose. But as physiologists are not agreed respecting the essential difference between arterial and venous blood, whatever properties the one possesses of which the other is destitute, any reasoning founded on such an uncertain basis must necessarily be unmeaning and inconclusive.

22. But to revert to the economy of the liver in the *fetus*, it may be observed, that besides the blood which is sent to it by the hepatic artery and *vena portarum*, it receives a large portion by the umbilical vein.

23. To understand this, we should advert to some of the peculiarities of *the fetus in utero*. It is very generally admitted, that the *placenta* is to the *fetus*,

what the lungs are after birth; that by both a change is induced in the blood, by which it loses the venous character, and assumes the arterial one, in such proportion as the exigencies of each may require. As soon as the change is wrought in the blood of the *placenta*, it is conveyed by the umbilical vein to the liver of the *fetus*; part of this blood mixes with the common blood of the *vena portarum*, and with concurs in furnishing the secretion of the bile; the remainder is carried into the *vena cava inferior* by the *canalis venosus*.

24. In the *fetus*, then, it seems that the blood in the *vena portarum* has more of the arterial condition than that of the adult, and seems to produce a bile of less activity.

CHAPTER IV.

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ON THE HEPATICK ARTERY, AND THE OFFICE OF THE BLOOD WHICH IT CONTAINS.

Sec. 1. By far the greater number of physiologists have agreed, that the hepatick artery carries blood to the liver for its nourishment, and that this is its only destination. There are a few, however, who incline to a different opinion ; and contend that, in addition to this function, it concurs with the *vena portarum* in the secretion of the bile.

2. The reasons on which this latter opinion is founded, have at least speciousness to recommend them ; and in our inquiry into this question, the merits of both opinions will be carefully investigated : and at the same time that we esteem it our duty to detect and expose fallacy wherever it appears, it is no less congenial to our inclination to ascribe to each argument its due and proper force.

3. The first position advanced in favour of this opinion is, “ That it is probable that “ the office of “ the hepatick artery is not confined to the nourish-“ ment of the liver, from the disproportion of its ves-

"fels to the bronchial arteries, which nourish the lungs."

4. In examining this argument, we find it is of an analogical nature ; and consequently, if well founded, cannot extend its force beyond presumption or probability. But we must always keep in view the difference between an analogy which is close, and where the points of coincidence are striking and well marked ; and one where they are but few, and those not very evident. Even the former will always fall short of proof, while the latter can scarcely warrant so much as a conjecture.

Therefore the object which is held out as the analogy cannot be two severely scrutinized.

5. This argument, then, rests on a presumption, that the lungs, which are at least as massy as the liver, are nourished by bronchial arteries, which are much less capacious than the hepatick artery ; therefore it has been said, if the bronchial arteries are sufficient to nourish the lungs, the hepatick artery ought to do something more than nourish the liver ; or, in other words, it ought to contribute somewhat to the secretion of bile.

6. The inference would be natural and fair, provided it were first established, that the bronchial arteries alone nourished the lungs.

7. Before the days of *Ruyssch*, physiologists imagined the lungs were nourished by the pulmonary artery ; they were the more persuaded of this, because

the existence of any other vessel going to the lungs had not been suspected. But *Ruyſch*, by his art of injecting, discovered the bronchial arteries; and these he considered as their true nourishing vessels; and what seemed to give strength and confirmation to this opinion was, that the blood, while circulating through the pulmonary arteries, possesses the venous character, and of course is unfit for nutrition; while that sent by the arteries of *Ruyſch* is in every respect adapted to this end.

But the following arguments may be adduced, not only from speculation, but from experiment, to prove that the substance of the lungs is nourished by the blood in the extreme branches of the pulmonary artery; and that the bronchial arteries of *Ruyſch* are confined to the nourishment of the branch of the *bronchiæ* alone.

As the blood in the smaller branches of the pulmonary artery is exposed to the influence of the air, it must necessarily receive a change, and assume the arterial character; in which state it is as fit for nutrition as the blood circulating in other arteries.

We learn from observation and experiment, that when inflammation has occasioned the surfaces of the pleura and lungs to adhere, such adhesions become vascular, and may be injected by the pulmonary artery; and, as the blood distributed to these adhesions is for the purpose of their nourishment, their communication with the ultimate branches of

the pulmonary artery proves incontrovertibly, that such blood is fit and proper for the nourishment of the lungs.

Hence it appears, that there is not the least analogy between the hepatick artery and the liver on the one hand, and the lungs and the bronchial artery on the other. Consequently the argument, which rested on this analogy, is not entitled to notice.

“ A second argument in favour of the hepatick artery assisting in the secretion of bile, is founded on an apparent communication between the ultimate branches of those vessels and the beginnings of the biliary ducts ; for, say the advocates for this doctrine, a subtile fluid may be injected with ease from one set of vessels to the other.”

That the biliary ducts may be filled by subtile fluid injected into the artery, we shall not deny ; but this fact does by no means prove a direct communication between one set of vessels and the other, as will very soon appear.

When we reflect on the circulation through the liver, it must be evident to us, that as the hepatick veins return blood both from the hepatick artery and the *vena portarum* ; the hepatick artery has communication with the latter by the intervention of the hepatick veins, and that a fluid injection thrown in by the artery will pass very readily into the veins ; where, if its *exit* be prevented by tying them up, it

may regurgitate into the terminations of the *vena portarum*, and thence escape into the *pore biliarii*.

But lest this explanation should be objected to as being too circuitous, another offers itself much more direct, and which admits of proof from injection.

Water injected by the hepatick duct passes with freedom into the hepatick veins ; and again, a similar fluid passes easily from the veins into the duct ; hence a fluid, injected by the artery, passes first into the veins, and afterwards into the *pore biliarii* ; so that the arguments founded on the phenomena resulting from injections cannot be admitted as proofs, that the hepatick artery exercises a secretory function.

The capacity of the hepatick artery with relation to the bulk of the liver, has been the ground on which its subserviency to the secretion of the bile has very much rested, from an idea that it carried to the liver more blood than the mere purposes of nutrition required ; hence it was imagined, that it either co-operated with the *vena portarum* in the immediate act of secretion, or that it separated from the blood, circulating through its extreme branches, a fluid which formed one of the constituent parts of the bile.

But the capacity of the hepatick artery does not necessarily suppose either one or the other of these offices ; for it is well known, that parts of the body, which are not secreting organs, are furnished with a larger proportion of arterial blood than the liver :

of this kind are the muscles, the brachial artery being larger with respect to the arm, than the hepatic artery is with respect to the liver.

Now muscles, we know, are organs which occasionally perform strong and repeated actions, which, like other actions when long continued, tend to debilitate and exhaust the machine; but, when their exertions are moderate, they become invigorated and enlarged, and the increase of bulk which they acquire in this way, is principally owing to an increase in the capacity of their blood-vessels, as appears not only from the more florid colour of those muscles, but likewise, from comparing the capacities of the trunks of these vessels with the muscles themselves.

Tendons, on the contrary, though parts equally alive, yet, from their more passive condition, require a supply of blood sufficient only for nourishment.

The brain is an organ which, with relation to its bulk, receives a larger quantity of blood than any other part of the body, yet its function as a secreting organ is not obvious.

The inference intended to be drawn from these facts is, that parts, though not secretory, require a supply of blood in proportion to the actions they perform.

Now surely we cannot hesitate to admit that the exertion of a secreting organ necessarily implies a considerable supply of vital energy, as it consists in changing the blood into a fluid different in all its

properties from the blood itself, so that it may assume a new mode of existence. In other glands, arterial blood serves the double purpose of being the *pabulum* of the secretion, and of supplying the organ with vital energy sufficient to effect its purpose; but in the liver, where the secretion is performed from venous blood, which is unfit for furnishing it with vital energy, the necessity for a copious quantity of arterial blood seems very evident.*

Admitting the *vena portarum* alone to be the secreting vessel, and that the hepatic artery furnishes blood only for imparting a due degree of energy, it

* An extraordinary case of *Lusus Naturæ* has lately occurred to Mr. Abernethy, Teacher of Anatomy; in which the *vena portarum* had a single termination. Instead of conveying its blood into the substance of the liver, prior to its termination in the inferior *vena cava* by the intervention of the hepatic veins, the blood returned by the veins of the different chylopoietick organs, was conveyed by the *vena portarum* immediately into the *vena cava* inferior near to the origin of the emulgent veins. The hepatic artery, which appeared to be somewhat enlarged, was the only vessel carrying blood to the liver, and in this individual instance it appeared to perform the double function of nutrition and secretion. That bile was secreted in this place, appears evident from the presence of it both in the intestines, and gall bladder. The latter, though of its usual size, contained only a small portion of this fluid, the properties of which were very similar to those of the bile in other young subjects. The subject of the present case was a child apparently about one year old, in every respect well nourished.

still remains a question, of what nature the communication between these two vessels is. Perhaps here it may be more consonant to the true spirit of physiology to content ourselves with the fact, and to trace its application to the economy of this organ, than to indulge ourselves in framing visionary hypotheses, which exist only in the efflorescence of fancy.

CHAPTER V.

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INTERIOR STRUCTURE OF THE LIVER.

Sec. 1. It is from the blood circulating through the branches of the *vena portarum*, that bile is secreted ; but in what particular part of this system the change commences, and what is the precise structure of the parts adapted to this end, are fit subjects for enquiry.

2. It has been already observed, that the ultimate branches of the *vena portarum* have a double termination ; one of which is, with respect to the circulation of red blood, by the beginnings of the hepatick veins ; the other with respect to the immediate secreting vessels, by the *pori biliarii*.

3. Does the change commence in the small branches of the *vena portarum* before they terminate in the hepatick veins ?

4. This is scarcely probable ; for any billious properties, which the blood may have acquired at this part, would be lost with respect to the hepatick duct, as it finds a more ready course through the hepatick veins : besides which the constitution would be in a continual state of jaundice.

5. The probability is, that there is no sensible alteration induced on the blood of the *vena portarum* before it terminates in red veins. And as arteries terminate in veins by capillary vessels, so, from the analogy which obtains between the *vena portarum* and an artery, we presume that the same termination does not take place until the branches have become capillary.

6. It follows from this, that the true secreting vessels are the very ultimate branches which communicate with the *peri biliarii*.

7. The next question is, how far the secretion of bile is connected with any peculiar arrangement or structure of these parts : or, in other words, whether the secreting vessel communicates with the beginnings of the excretory duct by a cylindrical continuation of canal, or by the interposition of a cell or follicle.

8. On this point, the opinions of *Malpighi* and *Ruyssch* divide anatomists : *Malpighi* having examined into the structure of glandular bodies, observed bundles of circumscribed knotty appearances assuming a globular form, to which he gave the name of *corpora globosa*; and by further examination, by means of injection, he found them still more conspicuous in consequence of distention; hence he inferred that they were hollow, and that each of them consisted of a cell or follicle.

9. *Ruyssch*, it seems, in the earliest part of life, embraced this opinion ; but from employing him-

self, frequently in exploring the structure of glandular bodies by injection, he was led to relinquish the doctrine of *Malpighi*, and to institute another which seemed to him more consonant to nature.

10. From his injections he was induced to believe, that the appearances described by *Malpighi* were fallacious ; and that they were not mere *cryptæ*, or cells, as they had been represented, but consisted of a series of vessels coiled up in a circumscribed form, and, that the ultimate branches of the secreting vessels communicated, both with the returning vein and excretory duct by a continuation of canal.

11. Without examining the merits of these doctrines, as applied to different glandular bodies, we may observe, that in the liver there are some appearances favourable to the Malpighian opinion. If a subtle injection be thrown in by the *væna portarum*, and the liver be afterwards cut into thin slices, there will be found knotted appearances, that bear a strong resemblance to cells, and which, from their inequality of bulk, and uniformity of shape, cannot be considered as the produce of extravasation.

12. The kidney likewise, when injected by the emulgent artery, rather minutely exhibits, in its cortical part, knotted appearances equally regular with those in the liver.

13. But here again the question returns upon us — *Do they, or do they not, consist of assemblages of vessels : or are they mere cavities ?* Feeling my incapacity

of solving this problem to the satisfaction of my readers, I must beg leave to withdraw myself from the contest in the beautiful language of the Roman poet :

“Non nostrum inter vos latus componere lites.”

CHAPTER VI.

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COURSE OF THE BILE.

Sec. 1. CONFESSING, then, our inability to determine the precise structure and mechanism of the parts, which form the immediate seat of secretion, it remains to trace the course of the bile from the interior part of the liver to the place destined for its reception.

2. The bile being formed, is conveyed from the seat of secretion, by the branches of the hepatic duct, which, at their origin, are very minute, and are there called *pori biliarii*. From these it passes into larger branches, and thence gradually into the trunk of the hepatic duct.

3. It is probable that the bile is not merely conveyed through these passages, but that it undergoes, during this course, a change from dilution to concentration ; for the numerous absorbents with which the liver is supplied, and which originate from its interior parts, make it highly probable that the more aqueous particles are removed by that system, and

carried into the circulation, leaving the remaining fluid in a more concentrated state.

4. The bile having arrived at the trunk of the hepatick duct, naturally passes forwards into the *duodenum*. But we are not to consider its motion as uniformly progressive, and without interuption ; for it is probable, from the oblique manner in which the biliary duct perforates the substance of the intestine, that the peristaltick motion of that gut, consisting in part of the contraction of its circular, and in part of its longitudinal fibres, will, by compressing the duct at its termination, occasion frequent, but momentary interruptions.

5. During these periods the duct must necessarily suffer a degree of distention, but which is soon relieved by means of a canal of communication with the gall-bladder, viz. the cystick duct. So that it appears, that the motion of the bile is not constantly in the same direction, but sometimes passing from the liver to the intestine, at others, from the intestine to the gall bladder.

6. In most subjects that we examine, this receptacle contains a considerable quantity of bile ; on an average, an ounce may be about the quantity.

7. If this bile be compared with that of the hepatick duct, it will be found thicker in its consistence, of a darker colour, and more pungently bitter : for here also, as well as in the liver, there are numerous

absorbents, which remove the watery parts. But, it is probable, that the increased viscosity depends in part on the mucus secreted by the gall-bladder itself, so that cystic bile may be considered as a compound fluid.

8. The gall-bladder then, appears to be an occasional receptacle for the bile, whenever there is an impediment to its passage by the common duct into the intestine ; and this, as a *diverticulum*, prevents a surcharge, which would probably take place in the hepatic duct.

9. That this purpose is answered, is probable from what takes place, when, from any cause, that the cystic duct is obstructed, for, in this case, the bile, finding no passage into that receptacle when its course into the *duodenum* is obstructed, necessarily accumulates into the *ductus choledochus communis* and *hepaticus*, and, consequently, enlarges the capacity of those canals.

10. For a proof that this is a law of Nature, we appeal to the dissection of morbid bodies where this complaint existed ; and there is a case in point, related by Dr. Ludwig, of Leipzick, in which the *ductus choledochus communis* was dilated to more than an inch in diameter.

11. This explanation of the course of the bile to and from the gall bladder appears the most satisfactory, and is that most usually received ; but the

establishment of it has met with opposition upon two grounds.

First, That the gall-bladder secretes its own bile ; and,

Secondly, That the branches of the hepatic duct, while in the substance of the liver, detach small canals leading immediately into the cyst ; and from which they have received the compound name of hepatico-cystick ducts.

12. The principal supporter of the former of these propositions is *Allbinus*. He was led to this from the vascularity of the gall-bladder ; from its internal surface having an appearance like follicles ; and from the gall-bladder having been found distended with bile, when the cystick duct was completely obstructed by a gall-stone.

The two first arguments are barely presumptive ; it will therefore be unnecessary to refute them in form.

The last, being more specious, may deserve some consideration ; we will begin with admitting the fact.

13. Now it is well known that the gall-bladder frequently contains biliary *calcula*, at the same time that it is distended with bile. Supposing, then, that one of these concretions happens to make its way into the cystick duct, and that the patient, being of an irritable habit, dies from this, or from any other

cause, and the body be examined under these circumstances ; in such a case the gall-bladder will be found distended with bile, when its retrograde course by the cystick duct is obstructed : but distention is from the bile previously contained in that receptacle.

Here then is a source of fallacy.

14. But if it be true that the gall-bladder is sometimes distended with bile, when the cystick duct is obstructed, it is no less so, that it is sometimes empty; and sometimes containing a fluid, composed principally of its mucus, tinged with a small quantity of bile.

15. The proposition relative to the existence of the hepatico-cystick ducts needs further support: they have been frequently sought for, in vain, in man and in other animals. In the ox some have contended for their existence. In the serpent tribe they certainly do not exist; for in these animals, the gall-bladder is detached from the liver, so that there is no possibility of communication, except by the intervention of the cystick duct. In the human subject, their existence may be easily disproved by experiment.

16. If the gall bladder be emptied of its contents, and either air or water be injected into the liver by the hepatick duct, neither of them will penetrate into the gall bladder. Now as fluids of so subtile a nature as these, would readily pervade those ducts if

they existed, we necessarily conclude that the gall-bladder receives its bile by the cystick duct.

17. But the causes which determine the retrograde course of the bile from the *duoūs communis* into the gall-bladder by the *duoūs cysticus*, are not constant and uniform in their operation ; they admit of intervals, during which this motion of the bile is either entirely suspended, or changed for one directly opposite. Were it not so, the gall-bladder would be in a constant state of surcharges, and of course become distended to an enormous size, so that a rupture of it would be endangered.

18. To guard against this evil, a part of its contents is occasionally discharged, from the pressure, which the surrounding parts are constantly making on it. Thus, this pressure will vary somewhat in its force from the relative degrees of distention of the stomach from food : and when the stomach is distended, there is the most copious flow of bile into the *duodenum*.

19. By this mode of discharging the contents, the gall-bladder is considered as a passive receptacle. But, this idea has been controveited ; at least it has not always been admitted in the extent here stated. Arguments, founded on analogy, have been adduced to prove that it possesses some active power on its own contents ; and that though assisted by the pressure of adjacent parts, as acted upon by the dia-phragm and abdominal muscles, yet that there is inherent in it a-power, by which it co-operates with

those agents, and relieves itself from any accumulation.

20. The analogy here alluded to, is the urinary bladder, which, by its own muscular power, is able to evacuate its contents.

21. Diligent search has been made by anatomists to discover muscular fibres in the gall-bladder, and such a structure has been described, but their precise direction is not yet agreed upon. This difference of opinion, though it does not disprove their existence, yet it weakens the probability of it; for, an appearance equivocally and indistinctly marked, as to admit of a diversity of descriptions, divides the mind too much to admit of its receiving any of them.

22. This difficulty has induced anatomists to adopt another criterion of muscularity, viz *irritability*; and with a view, either to establish or to disprove its presence, experiments have been instituted. Various stimulating powers, both chymical and mechanical, have been applied to the gall-bladder, without producing any evident contraction. Mechanical *stimuli*, indeed, produce no effect; and, when any contraction has followed the use of chymical application, it has been confined to such as acted by a corroding quality, and where the apparent contraction has been nothing more than the corrugation which may be induced on inanimate animal matter. Upon this subject the experiments of Baron Haller appear to be sufficient and decisive.

23. Having explained the powers by which the bile is conveyed from the liver and the gall-bladder into the duodenum, we are naturally led to contemplate the means by which its return from the duodenum is prevented.

24. The contrivance is simple and effectual. It consists of nothing more than the oblique manner, in which the common biliary duct passes through the coats of the intestine, from the external to the internal surface, and by which the office of a valve is performed; so that while the bile has a free passage from without inward, the orifice of the duct collapses when a contrary direction is attempted.

25. The causes which impede the flow of bile into the *duodenum* are generally very transient in their operation, under which state, there is only a moderate surcharge of the ducts, and no material inconvenience ensues. But it happens, not unfrequently, that the obstruction is of a permanent nature, in which case the bile is necessarily detained in these parts for a time, after which, it finds its way into the mass of blood, where, by being circulated through every part of the body, it gives yellowness to the skin and produces jaundice.

26. The causes which occasion this obstruction are various. A common one is the presence of a gall-stone either in the hepatic or common duct; perhaps the latter is more general, as biliary *calculi* form more frequently in the gall-bladder, where the

bile is in a state of quiescence, than in the branches of the hepatic duct, where it is in motion.

27. Sometimes a stricture of the common duct is an obstructing cause; such as have been discovered after death, are usually of that permanent kind connected with a diseased condition of that part, a removal of which can scarcely be hoped for.

28. But a cause of jaundice has been referred to a spasmodick stricture of this duct, and which, as not being connected with a change of organization, may attack by paroxysms, returning at indeterminate periods.

29. Without examining into the symptoms which have been supposed to characterise this cause; it may possibly be thought a sufficient refutation to prove, that the biliary ducts of a living animal possess no marks of irritability when acted upon by *stimuli*; the contrary of which we should expect were they furnished with muscular fibres.

The only part of the common duct liable to spasmodick affection, is that which passes through the coats of the *duodenum*, which may be acted upon by the muscular fibres of that intestine; and here we should distinguish between the contraction of the intestine in which the biliary duct is passive, and a contraction of the duct itself.

30. Another cause of obstructed bile consists in a pressure of the duct by the head of the *pancreas*, which is sometimes found in a schirrous state, and which from its connection, may easily produce such

an effect : for the biliary duct, a little before it terminates in the intestine, penetrates some way into the substance of the *pancreas*, and receives the excretory duct of that gland. Therefore the orifice which appears on the inner surface of the *duodenum* transmits, in common, the bile and pancreatick fluid.

31. To the causes of obstruction already enumerated, there is another sometimes annexed ; viz. a schirrucus impacted slate of the liver, which from a very extensive deposit of solid matter throughout its substance, in an interstitial form, diminishes the capacities of the *peri biliarii*, so that they are unable to carry off the bile as fast as secreted, and an accumulation of it within the substance of the liver must therefore necessarily ensue.

32. Hitherto the cause of jaundice has been referred to obstruction in some part or other of the biliary ducts. But there are some cases which incline us to believe that jaundice may exist, though the biliary canals are pervious and free. The yellow fever of the West Indies furnishes an instance in point. The characters of this complaint are a diffusion of bile through the mass of blood, producing jaundice, with an excessive quantity of it in the alimentary canal, so that it is discharged by vomiting and purging. In this eas , jaundice seem to depend upon a redundant secretion.

33. But *Bourbaeve* and *Morgagni* have favoured an opinion the direct reverse of this. They consider jaundice, sometimes, as the effect of a suspended se-

cretion, and suppose that the blood, in consequence of this, retains a bilious character, thereby giving yellowness to the skin.

34. This opinion is founded on a mistaken notion, that all the secreted fluids pre-exist in the mass of blood ; and that the province of the different glands is confined to the mere mechanical separation of these fluids

35. As there are few, if any physiologists, of the present day who entertain such an opinion of glandular secretion, to offer any thing of an argumentative nature, by way of refutation, would be altogeth or superfluous. It is now generally understood and believed, that the blood is the *pabulum* or source of all the secretions, and that the glands through which it circulates change its properties, every one according to its peculiar mode of action ; so that the secretions may be considered as new fluids formed by their respective glands.

36. If this idea of secretion be true, it must necessarily follow, that, if the action of the whole secreting system of the liver be arrested, no bile can be formed, and consequently none can be conveyed into the mass of blood. To argue otherwise would be to oppose every principle of reasoning ; it would be imputing effects to a cause which has no existence.

37. In every case of jaundice bile must be secreted and carried into the blood vessels ; but the channel

by which it is conveyed has given rise to controversy.

38. There are on this subject two opinions which divide physiologists ; some of whom assert, that the bile after secretion is carried to the blood-vessels by regurgitation, whilst others attribute this effect to absorption.

The first opinion has most generally prevailed.

39. BARON HALLER, who introduced this to our notice, rests his opinion on the free communication of vessels in the interior part of the liver ; but more especially on a communication between the hepatic veins and biliary ducts. The proof of this communication is fair and decisive.

40. He observes that a subtle injection thrown in by the hepatic duct will escape readily by the hepatic veins. This is a fact ; and I know from experiment that the water injected in the same direction will return by the veins in a full stream, though very little force is used. From the facility with which water takes this retrograde course, a probability arises, that, if from any cause the natural direction of the bile be obstructed, it will naturally obey the same direction.

This explanation of jaundice seemed fully sufficient to satisfy the mind of Baron Haller.

41. But a more extensive acquaintance with the economy of the absorbent system has given a new turn to this speculation, and has induced a physi-

elogist of the present day, to solve the cause of jaundice on the principle of absorption only. This opinion rests on an experiment, where the hepatick duct of a living animal was tied, and afterwards the absorbents of the liver were very much loaded with bile.

42. This fact certainly proves that the absorbents have the power of taking up bile ; a circumstance which I apprehend would be generally admitted, though it had not received the confirmation of experiment. But it does not invalidate the probability of a part passing into the blood-vessels by the hepatick veins ; the circumstances and facts upon which that opinion rests, retain all their original force, and stand unaffected by this experiment.

43. The question then seems to be whether in cases of jaundice the bile passes into the blood vessels by regurgitation, by absorption, or by both channels ?

44. That the absorbents take up the bile from the interiour part of the liver, and convey it by the thoracick duct into the mass of blood, the following experiment will evince.

EXPERIMENT.

45. An incision was made into the abdomen of a living dog, large enough to allow a ligature to be

made on the hepatick duct ; this being done, the parietes of the abdomen were brought together by sutures. Two hours after, the dog was strangled, and the parts carefully examined. On inspection it appeared that the absorbents had been very active, for they were very much distended with a fluid of a bilious colour, and their course, which was very conspicuous, could be traced with the greatest ease to the thoracick duct, the contents of which seemed only moderately billious. The billious colour was in a great measure concealed by the red particles of blood, which had been extravasated by the injury, taken up by the absorbents, and conveyed into that canal. It is probable, however, that the bile was only just entering the blood vessels, as on a very careful inspection of the eye, tunica conjunctiva did not betray the slightest appearance of jaundice.

46. It seems then that during the space of two hours, the secretion of the liver had been sufficient in quantity to distend its ducts ; to stimulate the absorbents to relieve that distention ; and to allow of a small portion of their contents to be conveyed into the blood vessels.

47. But it still remains to determine, whether or not a small quantity of bile was not regurgitating by the hepatick veins during the process.

48. To ascertain this, a second dog was procured, and ligature made on the hepatick duct as in the preceding experiment. Two hours after, blood was

taken from the jugular vein, and set to rest, in order that it might separate into its *serum* and *crassamentum*. The liver was then drawn down a little from the diaphragm, and blood taken from one of the hepatic veins. This blood as well as the former, was allowed to separate into parts : and on immersing pieces of white paper into the *serum* of each, *that* taken from the hepatic veins gave the deepest tinge, the *other* produced *only* a very slight degree of discolouration.

49. In this experiment the period of examination was the same as the last, viz. two hours ; a space of time just sufficient for the bile to begin to make its way into the circulation without having poured in such a quantity as to tinge in any sensible degree the general mass of blood. Hence we see evidently why the blood which was returning from the liver by the hepatic veins, contained a larger proportion of bile than that taken from the general circulation.

50. As the first of these experiments proves, that the absorbents of the liver are concerned in the production of jaundice, so the last demonstrates with equal force, when from the operation of any obstructing cause the bile is accumulated in its ducts, so as to distend them in a considerable degree, Nature relieves herself, in part, by allowing a portion of it to take a retrograde course by the hepatic veins.

CHAP. VII.

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BILE.

Sect. 1. This fluid, upon bare inspection, is apparently homogeneous ; of a green colour, in which a yellow shade is very conspicuous when the bile is diluted with a watery fluid ; but if examined in its more concentrated state, of a deep green. Hence it is that the dilution of this fluid by the more watery parts of the blood gives the yellowness of jaundice.

2. The consistence of bile is usually viscid, and its tenacity is sometimes such, that it cannot be poured from a phial in drops, but is drawn out into threads like the *albumen*. It is observed to be more viscid in the human subject than in brute animals.

3. But a question may here arise, how far this tenacity is essential to the bile, or whether it may not be explained on the principle of its being a compound fluid consisting in part of genuine bile, with a portion of that mucus which is secreted by the gall-bladder ;

for it is the bile contained in this receptacle, which is usually the subject of chymical experiment.

4. When bile is agitated in a phial, it forms a lather in the form of soap and water ; and that it possesses saponaceous properties is rendered highly probable from the use to which it is applied by scourers of cloth ; it being known to assist very powerfully in the removal of greasy spots.

5. To these sensible properties we may add its taste and smell ; the first being intensely bitter, with a degree of pungency ; the last of a faint and nauseous nature.

6. From this assemblage of properties, we naturally presume, that bile is a saponaceous fluid, combined with a mucilaginous substance, from which it receives its tenacity ; and to these are superadded the green colouring matter and the principle of bitterness.

7. It is therefore the province of chymistry to determine, by careful and accurate investigation, in what degree these conjectures concerning the nature of that fluid can be confirmed by experiment.

8. In the first dawnings of chymical knowledge, when our acquaintance with the agents of chymistry, and their effects on matter, was narrow and confined, the means usually employed to ascertain the component parts of bodies, were seldom any other than those of subjecting them to distillation by different degrees of heat, from the less violent to the more in-

tense. Having exerted the whole power of the furnace in this way, the enquirers thought themselves in possession of a very perfect *analysis* of every body, which they thus submitted to investigation.

9. But reflection and an extended state of knowledge soon convinced them how remote they were from a thorough acquaintance with the constituent parts of bodies ; and their unsuccessful attempts to reproduce the original substance, by a recombination of such of its elements, as they, in this way, were able to collect, soon convinced them, that another, and less fallible, mode of prosecuting these inquiries was very much to be wished.

10. Besides, they were not acquainted with the nature of the agent they employed, either abstractedly, or in a state of combination with matter ; therefore the changes thus induced could be but imperfectly understood.

11. To guard against this difficulty, another, and more natural, mode of investigating bodies was introduced, viz. the forming of different compounds by the addition of certain chymical re-agents ; and in this way it was found that a more correct analysis could be obtained. Thus the torturing of bodies by the application of *heat* necessarily yielded to the more natural examination by chymical attractions.

12. It is by no means intended here to proscribe

altogether the agency of *heat*, it being often found essentially useful, as an auxiliary, to the chymical bodies employed, enabling them the better to effect their different decompositions and combinations.

13. A quantity of *recent ox bile* being procured, several experiments were instituted with a view to ascertain its component parts.

EXPERIMENT I.

14. A portion of it, being received into a shallow earthern vessel, was evaporated cautiously by a moderate heat. On examining the vapour it appeared to be principally, water possessing neither acid nor alkaline properties, but strongly impregnated with that principle, in which the peculiar odour of bile chiefly resides. The *residuum* gradually inspissates, and assumes the form of an extract; which, if the evaporation be carried sufficiently far, will become as brittle as resin, and may be pulverized with equal ease.

15. From this experiment we learn that the fluidity of bile depends chiefly on *aqueous* matter, and that in the exhalation of it, even by the more moderate degrees of heat, it is accompanied by the odorous principle, which, it seems, is of a very volatile nature.

16 As bile possesses a considerable degree of tenacity, and as the tenacity of animal fluids depends chiefly on a mucilaginous principle, it was determined next to ascertain whether that principle gives viscosity to the bile.

EXPERIMENT II.

17. On a portion of bile was poured a quantity of alcohol; a *coagulum* was immediately formed, which floated in a green liquor. On filtering this compound, the green fluid readily passed, while a mucilaginous substance of considerable tenacity was detained by the paper. This mucilage was of a whitish colour, and possessed only a slight degree of bitterness, while the filtrated liquor preserved both the billious colour and taste. It is scarcely necessary to add, that it was free from viscosity. The glutinous principle of the bile appears then to reside in an animal mucilage.

18. The *fluidity*, *odour*, and *viscosity* of bile being thus accounted for, we are next led to the investigation of the principles on which its bitterness, colour, and saponaceous quality depend.

EXPERIMENT III.

19. To a quantity of recent bile was added a dilut-

ed marine acid ; a coagulation was produced. The fluid separated by the filter was of a green colour, but much lighter than that of bile ; and, notwithstanding the predominance of the acid, the bitter taste was very distinguishable.

20. The more solid matter detained by the filter was very glutinous, of a green colour, and intensely bitter.

EXPERIMENT IV.

21. Two other portions of bile were put into proper vessels ; to one was added a diluted vitriolic, to the other a diluted nitrous acid. Both exhibited *phenomena* similar to those in the last experiment. The filtrated liquors were green, and bitterish ; the *coagula* intensely so, and glutinous.

22. As, in these experiments, the decomposition appeared to be incomplete, it was thought eligible to try, whether or not a more perfect separation might be obtained by the assistance of heat.

EXPERIMENT V.

23. A quantity of bile and diluted marine acid were put into a flask, and placed in a sand-bath until they had acquired the boiling heat. On inspection,

the separation into parts was very evident; and on committing it to the filter, it separated a colourless fluid destitute of every billious property. The *residuum* consisted of a very dark green mass, intensely bitter, and extremely glutinous. When examined, it appeared to be composed of an animal mucilage, in combination with a resinous substance.

24. But to ascertain in what way the acid had affected the decomposition, it became necessary to examine the filtrated liquor. It was therefore subjected to a cautious evaporation, and, at a proper period was suffered to cool.

25. Under cooling, chryſtals were formed of a cubic figure, which decrepitated by heat, and possessed all the characters of common salt.

Therefore the decomposition was here occasioned by the marine acid engaging the mineral alkali, which it separated from the other element of the saponaceous body, and, by uniting with that *basis*, formed common salt.

26. But, notwithstanding we are able to account for the production of common salt in this way, it does not exclude the possibility of a small quantity of it pre-existing in the bile, independent on this artificial combination of its elements.

27. To satisfy my doubts on this point, the following experiment was made.

EXPERIMENT VI.

28. To a portion of bile was added alcohol, in quantity sufficient to set loose all its mucilaginous matter. The fluid part, being separated by a filter, was examined by nitrated silver, but no *luna cornea* was produced : therefore the marine acid (the acid principle of common salt), does not appear to have any existence in the bile.

29. From this experiment we learn, that the saline basis of the saponaceous matter of the bile is the mineral alkali ; but the other element is still a question.

EXPERIMENT VII.

30. To determine this point a quantity of bile was decomposed by a diluted marine acid, assisted by heat (as in Experiment V.) The *coagulum* detained by the filter was examined. It appeared to possess most of the characters of bile in a solid concentrated state. It had a pungent bitter taste, dark green colour, and was extremely glutinous. When perfectly dry, it was very inflammable, and burned with as much rapidity as any bituminous substance would do.

31. This appearance led to a suspicion of the presence of a resin, but as a higher degree of certainty was still wished for, further experiment was necessary.

EXPERIMENT VIII.

32. I therefore diffused a portion of this *residuum* through rectified spirit of wine : a large portion of it was dissolved, which imparted to the spirit both the colour and taste of bile ; the insoluble part being chiefly of a mucilaginous nature.

33. From the facility with which alcohol dissolves the green and bitter part, it is scarcely probable, that it partook of the nature of an unctuous oil ; but that it was either a resinous body, or a kind of essential oil.

34. This point was easily determined : for, on the addition of water to the solution, a precipitation took place. The filtered liquor was colourless and free from bitterness. The *residuum* was nothing more than a resinous substance, in which resided both the colouring principle and bitter taste.

35. On taking a retrospect of the above experiments, the bile appears to be resolvable into the following elements, viz.

First, — Water, impregnated with the odorous principle.

Secondly, — A mucilaginous substance resembling the *albumen*.

Thirdly, — A resinous substance containing the colouring principle and bitter taste. And,

Fourthly,—The mild mineral alkali.

36. With respect to their combination, it seems that the saponaceous matter consists of the bitter resin in union with the alkali : this admits of a ready union with a mucilage, and with this again the aqueous matter very easily combines, so that the whole forms a mass apparently homogeneous.

37. The following experiments were instituted with a view of examining some doctrines, founded on the bile having a greater power of resisting putrefaction than the blood.

EXPERIMENTS IX & X.

38. Equal quantities of blood and bile of the same ox were each put into a different vessel of the same size, and exposed to the same degree of heat. On the third day the blood began to give out by its odour, marks of putrefaction ; the bile remained in its natural state.—On the fourth day the bile had a pungent odour by no means ungrateful, while the blood was extremely putrid.—On the sixth day the bile became putrid, and had a very offensive smell.

CHAP. VIII.

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ON BILIARY CALCULI.

Sec. 1. BEING favoured by Dr. Baillie with an opportunity of examining the structure, and general appearance of biliary *calculi*, in his collection I found that they are very generally either of a lamellated or radiated structure : on the outer surface chiefly of the former ; on the inner of the latter. The colour is extremely various : in some they are of a light colour, approaching to a white ; in others as black as jet ; in many of a brown or ochry appearance ; these last have generally a very bitter taste ; the radiated part is frequently white, and without taste.

2. They are, very generally, inflammable, and fusible in the fire ; and, for the most part, they are soluble in spirit of wine, and oil of turpentine. There are some, however, which are not soluble in either of

these fluids. Many of them have the consistence of phosphorus, and cut like wax.

3. In the radiated *calculi* there is a substance, in every respect, like *spermaceti*. Some *calculi*, instead of burning with a flame, only become red, and consume to an ash, like a cinder.

4. This variety in the appearance of *calculi* clearly evinces that they are not mere inspissations of bile, but that there is a difference either in the component parts themselves, or in the proportion of those parts.

5. Therefore in chymical investigation, it seems necessary that experiments should be made on different specimens, as it is probable, even *a priori*, that the result of experiments made on one specimen, will not apply, very strictly, to a series of inquiries made on another.

6. As we presume, from bare inspection, that these *calculi* are not mere inspissations of bile, but that, they contain principles which are not to be found in that fluid, it affords a subject of rational inquiry, to determine what are those elements, and of what nature is their combination.

7. To ascertain this, several experiments were instituted on a calculus of the following characters.

The external surface was of a chocolate colour; when rubbed off, it had a lighter coloured layer underneath.

On making a section through its centre, it appeared to be composed of lamellæ.

It was rubbed to powder very easily.

Its taste was moderately bitter.

It was fusible by heat, and when inflamed, burned like a resinous substance.

Ol. terebinth. unaided by heat, dissolved a very large portion ; but alcohol, under the same circumstances, dissolved only a small part.

8. To determine how far the agency of heat could assist the solvent power of alcohol, an experiment was made.

EXPERIMENT.

Twenty grains of this calculus were infused in an ounce of alcohol, and, after previous agitation, the phial was placed in a sand bath. Before the fluid had arrived at the boiling point, it dissolved nearly the whole of the substance. The clear liquor, being poured from the residuum, was suffered to cool. Under cooling, the whole assumed the appearance of a solid chrysalized mass.

EXPERIMENT.

9. A small quantity of alcohol being poured on this residuum, and assisted by heat as before, exhibited

very little solvent power. These experiments show that there is a small proportion of this biliary calculus which resists the solvent power of alcohol. What is its nature?

EXPERIMENT.

10. To this residuum was added a quantity of diluted marine acid. A sufficient time having elapsed, the fluid was committed to the filter. To the clear liquor was added a portion of the aq. kali, and a white precipitation, apparently of an earthy nature, immediately took place.*

Hence one point in which a biliary calculus differs from fluid bile is, in containing a quantity of earthy matter.

11. The crystallized mass formed by the alcohol was next subjected to examination. Some of the phenomena already related having led to a suspicion, that a resinous matter forms one of the constituent parts of biliary calculi, the proof of it was reserved for the following experiment.

* I suspect it to be of an earthy nature, not only from its solubility in acid, but from its possessing no inflammability.

EXPERIMENT.

12. The chry stallized mass, being made fluid by heat, was poured into a pint of water ; a white flocculated precipitate was immediately formed, leaving an opaque supernatant liquor. The whole was committed to the filter, and the solid part being collected and dried, was found to be of a resinous nature.

EXPERIMENT.

13. To the clear filtered liquor was added a small quantity of diluted marine acid, from a suspicion that an alkaline principle might form one of the constituent parts of a gall stone, as well as of the bile, and by that means a small portion of the resinous substance might still be held in solution ; but no precipitation followed. This experiment makes the presence of an alkali somewhat equivocal ; but the following proved its existence very satisfactorily.

EXPERIMENT.

14. The fluid mixture of the last experiment was carefully evaporated almost to dryness. On cooling, two kinds of chry stals formed ; one spiculated, the

other cubick. The cubes, possessing the characters of common salt, proved the presence of the mineral alkali : and the spiculated crystals, which were the common crude sal ammoniack, afforded presumptive evidence in favour of the volatile alkali. But what placed the matter beyond doubt was the following experiment.

EXPERIMENT.

15. A drop or two of aq. kali was added to these crystals, and the volatile alkali became immediately sensible.

16. From these experiments we infer, that this specimen of biliary calculus consisted chiefly of a resinous matter, with a small proportion of earth, apparently calcareous, combined with the mineral and volatile alkali.

CHAP. IX.

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OF THE USE OF THE BILE.

Sect. 1. GREEN and bitter bile being in common to all animals with red blood, and found only in such, makes it probable that there is some relative connexion between this fluid and the colouring matter of the blood, by the red particles contributing more especially to its formation. An opinion very generally prevails, that the bile assists in the process of chylification, by mixing with the digested food contained in the *duodenum*: for it is demonstrably true, that the digested matter does not assume a chylous form until it has passed below that part of the intestine where the biliary and pancreatic ducts make their entrance. And upon the ground of this fact, it has been presumed, rather than demonstrated, that either all, or some of the constituent parts of the bile contribute to chylification. What foun-

dation exists for such an opinion, the following experiment will tend to show.

EXPERIMENT.

2. A dog was fed with animal food, and in three hours the *abdomen* was opened.—A portion of the *duodenum*, and *jejunum* of considerable length, was cut open, so that the contents might be observed. Portions of food, reduced to a pultaceous mass, were seen oozing through the *pylorus*; the bile was likewise observed to pass slowly out of its duct, which, when carefully attended to, appeared to flow over the surface of the digested matter adhering to the intestine. Upon removing the bile from the surface of this digested matter, it did not appear to have mixed with it in any sensible degree.

3. Hence it seems somewhat doubtful whether the bile really forms one of the constituent parts of the chyle, as has been imagined, or not. If, however, all, or any of the elements of bile do contribute chylification, no traces of their presence can be discovered from the sensible properties of the chyle.

4. Another difficulty in admitting this as one use of the bile, is from the circumstance of jaundice. In this complaint, the passage of the fluid into the intestine is either completely obstructed, or very much

impeded; but there are no symptoms which clearly manifest a defect of chylification.

5. One important use of the bile is, unquestionably, that of stimulating the intestine, and performing the office of a purgative; for when the excretion is impeded, as in the jaundice; the intestines, being deprived of their natural *stimulus*, become torpid, and constiveness ensues.—This torpor is diffused by sympathy over every part of the system, and languor and listlessness prevail.

6. It is probable, therefore, that even admitting the bile to contribute somewhat to the digestion and assimilation of our food; its principal office is that of a natural and habitual *stimulus* to the intestines, keeping up this energy and peristaltick motion, which may be affected either by an increase of its quantity, or a change in its quality, produced by disease.

When we take, however, a view of the constituent parts of bile, as clearly ascertained by the foregoing chymical experiments, it seems very probable, that from its resinous bitter, it may counteract any active and spontaneous changes to which animal and vegetable matter would otherwise be subject; and that as the propensity to acidity in our vegetable aliment is extremely obvious, the alkaline matter of bile tends to correct it. Bile likewise, from its saponaceous and soluble quality, lessens the adhesive

nature of our faeces, and, by smoothing their surface, promotes their evacuation. In cases of defective secretion the faeces are hard, knotty, and irregularly fixed. One important part of digestion is ultimately perfected in the upper end of the duodenum ; and as perfect digestion is always opposed to fermentable changes, the bile is well calculated to finish that process. We probably may err in confining the use of bile, therefore, to any single operation, while from its nature it seems so well qualified to answer a variety of useful purposes in the animal economy. We shall afterwards observe, that where it is defective it may be imitated by artificial means with advantage ; and in no instance has the application of chymistry to the cure of diseases appeared more successful than in suggesting the use of proper remedies in cases of diseased and defective bile.

It frequently occurs that bile is secreted in too small a quantity, as in hypochondriacal complaints and chlorosis ; in which diseases an unusual degree of torpor takes place, expressed in the one case by dejection and despair ; in the other by inactivity and languor ; the stools are generally of a light clay colour, and the body is costive.

Bile therefore affords a stimulus by which tone and energy are communicated from the intestines to the whole body, the defect of which on the primæ

viæ is more productive of disease than its excess. In the latter case, if it be healthy in its nature, it only proves a salutary purgative, but if in a diseased state, it deranges the animal economy like any foreign stimulus which may be applied to the intestines.—It likewise, from its bitterness, possesses antiseptick powers, which are peculiarly useful in the intestinal canal.

OF THE DISEASES OF THE LIVER DE-
PENDING ON ITS FUNCTIONS AS
AN ORGAN OF SECRETION.

CHAP. I.

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ON THE INCREASED SECRETION OF BILE.

Sect. I. The Inhabitants of warm climates are extremely subject to diseases arising from the increased secretion of bile, and the excess of its quantity in the primæ vicæ, which, either by regurgitating into the stomach produces a general languor of the body, together with *nausea*, foul tongue, loss of appetite, and indigestion; or, by being directed to the intestines, excites a painful diarrhoea, ultimately tending to weaken their tongue, and disturb their regular peristaltick motion. It generally happens that, during the excess and prevalence of bile in the first passages, some absorption of it takes place in the habit,

so that the skin becomes yellow, and the urine sensibly impregnated with it. The pulse is quicker than natural, and there is a considerable degree of thirst, with an increase of heat, the usual symptoms of fever. The body becomes emaciated, and the general aspect of the patient is extremely unhealthy.

2. Under such circumstances, a change of climate becomes necessary, by which the secretion of bile is gradually diminished, its power, perhaps, rendered less active, and the healthy functions of the stomach and bowels are again restored. A sea voyage from a warm to a colder climate generally effects this purpose, supposing, as is frequently the case, that the liver and other abdominal viscera are in a sound state.

3. Such symptoms as I have now enumerated are the spontaneous effects of a warm climate on healthy constitutions, independent of any intemperance, and cannot always be prevented by the most careful attention to diet, or by avoiding such irregularities, as, in all situations, contribute to produce disease.

4. The natives of warm climates are less subject to the inconveniences arising from the increased secretion of bile than Europeans, who inhabit those countries, and whose constitution, by former habits, is ill prepared to admit such increased excitement of the liver or such additional irritation on the pri-

mix viæ, without much derangement of the animal economy. The bile in warm climates is, perhaps, more bitter and more saturated with its component parts than in colder countries ; it is therefore a more active emetic or purgative ; and, although it was not secreted in a larger quantity, its effects on the first passages would be more severely felt.

5. We have had occasion, in treating of the nature and properties of bile, to correct a common and prevailing opinion of its being extremely putrescent ; experiments, executed with great accuracy and fidelity, sufficiently prove that it is less disposed to putrify than other animal fluid ; and that it even preserves, in a sweet state, animal substances, which, when exposed to similar circumstances of fluidity and heat, without the admixture of bile, would in a shorter time have assumed the character of putrefaction. It seems, therefore, to be a wise law of the animal economy, that in warm climates, a larger quantity of this fluid should be prepared by the constitution than in colder countries ; and by its being more bitter and more active, it possesses a greater antiseptic power than the milder and more diluted fluid of a colder climate ; hence it is better fitted to correct and restrain the propensities to spontaneous and putrid fermentations, so extremely prevalent in warm climates.

6. I do not, however, mean to deny, that many and great inconveniences are found to arise from the prevalence of bile in the primæ viæ ; but I am firmly persuaded, that a diminution of its natural quantity would produce diseases of a more permanent and alarming nature. It is more difficult to supply the defect in the quantity of this fluid, than to carry off its excess ; it is even more easy to diminish its acrimony than to increase its power, and thereby render it more active, and better suited to answer the various and useful purposes intended by it to the animal economy.

7. I have been frequently consulted by persons whose appetite and digestion have been much disturbed by a long residence in tropical climates ; and who, although they have generally received much benefit by a sea voyage, and a gradual return to Europe, yet require the assistance of medicine, with a view to destroy the tendency to excessive secretion, and finally to restore strength and vigorous action.

8. After obtaining all the information which I suppose necessary respecting the constitution and habits of the patient, the original and progressive state of symptoms, and the effects of such remedies as have been employed, I proceed to ascertain how far any local or organick affection of any of the viscera has taken place.—If, upon investigation, I find that the constitution has only suffered by the prevalence or

the excess of bile, and that the disposition to that morbid increase of secretion still remains, disturbing the functions of the stomach, and irritating the bowels, I recommend it to my patient, every morning before breakfast, to dilute the contents of the stomach, by drinking from half a pint to a pint of water, of a temperature from 90 to 114 degrees of Farrenheit's thermometer, likewise to take a moderate degree of exercise before breakfast. This may be done either in London or in Bath, though I am persuaded, that the benefit derived is by dilution, and that tepid water dilutes better than cold water, and that pure water dilutes better than water impregnated with saline, earthy, or metalick matter.— I do not, however, mean to discourage invalids from going to places of publick resort, which may contribute, by their amusements, to restore a constitution enfeebled by a warm climate, or intense application to business.

9. The cymical analafis of mineral waters has been of considerable advantage, since, besides the discoveries which it has made with respect to the solid contents of many of them, it has also proved, with respect to others, which contain but little solid matter, that it is the quantity of water, and not the impregnating substance, which does good.

I believe the experiment of drinking good pump

water at home, of the temperature of Bath, Buxton, or Bristol water, has seldom been tried. I have frequently, with much success, recommended the use of warm water in dyspeptic cases ; and in anomalous gout, it seems to allay the irritation of the stomach, to promote and diffuse a generous warmth in the extreme parts, and, if taken at night, will generally produce sleep. Perhaps it acts upon the principle of tepid bathing ; with this difference, that any action of the stomach has a more extensive influence on the system, than the same action would have on the surface of the body.

10. Water heated to a certain degree, when taken into the stomach will produce giddiness of the head, while the same water, of a lower temperature, will produce no such effect : this is the reason why patients at Bath are directed to drink the water of different springs, though not differently impregnated, and it gives rise to a refinement in practice which has for its foundation only the different effects of temperature. It is not improbable, but that more benefit will arise when the temperature is carried to that degree which produces some sensible effect upon the head ; it is impossible to lay down any general rule on this subject ; it is trial alone on the individual that can determine the point of action.

11. I consider the waters of Bath, Bristol, and

Buxton, as not having any powers superior to common pump water, heated to the same temperature. The steadiness and uniformity, however, of their several temperatures entitle them to some preference, and render them proper to be drunk by persons whose stomachs are irritable; and impatient of their contents, and perhaps weakened in their digestive powers by long habits of ingurgitation and goutony, or from intense application to study, accompanied with a sedentary life.

12. In sick headaches, which generally arise from bile in the stomach, half a pint of warm water taken at bed-time has a good effect. In all cases where bile is secreted in too large a quantity, the use of emetics is improper; they increase the irritable condition of the hepatick system, and divert the bile from the intestines. In almost all cases where vomits are given, bile, during their action, is forced from the *duodenum* into the stomach, which would otherwise have been carried off by the intestines; indeed, the actions of nausea and vomiting increase its secretion. In general, bile is a purgative sufficiently stimulating for its own evacuation, only requiring the assistance of warm water for facilitating its discharge: if, however, in some cases, it irritates without purging, I would recommend the use of the neutral salts, such as soluble tartar, sal cathart.

cus amarus, and the like ; and in all cases they do most good under dilution.

13. This suggests the propriety of recommending the use of Cheltenham water to persons returning from warm climates. It may be drank either with or without its chalybeate part, but at all events its dose should be such as to produce a purgative effect. Perhaps it would be more advantageous to take it every other morning than to use it daily : it may be successfully and well imitated by artificial means, so as to be drunk at a distance from the spring nearly with equal effect as at Cheltenham.

14. The stomach, in its energy and power, is greatly assisted by warm clothing, especially on the lower extremities of the body. The diet of a patient, whose stomach and bowels are extremely irritable by the excess and prevalence of bile, should be moderate in quantity, and of easy digestion. This will necessarily exclude melted butter, every thing fried, every species of pastry, together with cold, and raw or unboiled vegetables. Ripe fruits may be admitted, in moderate quantities, rather before than after dinner. Water, or wine and water, may be drank for common use. Spiritous liquors of all kinds should be avoided, as having a tendency, more directly, to produce diseases of the liver, and to weaken the tone of the stomach.

15. The CHOLERA MORBUS may very properly be considered under the head of those diseases which depend on the increased secretion of bile. It takes place, with different degrees of violence, in different habits : in some it is so acute as to prove fatal in a few hours, while in others it is expressed only by a slight purgative and emetic operation. In general the symptoms are as follow.

16. The patient is seized with a violent discharge of a dark coloured fluid, in large quantity, and somewhat of a bitter taste, both from the stomach and intestines, with much pain and anxiety about the *præcordia*, together with cramps or spasms, particularly of the lower extremities ; there is a considerable degree of thirst, the pulse is extremely quick and weak. When the disease proves fatal, the pulse intermits and becomes more feeble, the extremities become cold, the patient is seized with hiccup, and dies in the same manner as persons do from inflammation of the bowels.

17. This disease is extremely prevalent in this country, in the months of August and September, so as to be considered as an autumnal epidemick. It frequently takes place spontaneously, and independently of any sensible occasional cause being applied ; at other times it is evidently connected with a sudden change of temperature in those months.

18. It may likewise arise from the intemperate use of food of difficult digestion, and unripe fruits. In autumn the hepatic system is more irritable in this country, than at any other season : and the diseases which prevail in the months of August and September, are obviously connected with the state of the biliary secretion, and approach in their nature to such as prevail in warm climates.

19. The fluid discharged in the *Cholera Morbus* is evidently bilious, but it is bile in a very diseased state, by no means corresponding with the character of the natural or healthy state of that fluid.

20. It seems probable, that from the quantity secreted, and the rapid manner in which it is poured into the duodenum, there is not time sufficient for a perfect secretion, that the fluid therefore is somewhat of an intermediate nature between blood and bile. Perhaps, from a hurried circulation, a considerable quantity of red globules escape, unchanged, from the capillary vessels into the *pori biliarii*, and uniting with a portion of bile, are carried by the hepatic ducts into the duodenum.

21. The varied and increased action of a gland has much influence in determining the nature of the fluid secreted. In some cases, bile is discharged of a green colour, and extremely acrid, not possessing the qualities of healthy bile.

22. The cure of *Cholera Morbus* is best effected, by first diluting the contents of the stomach and intestines by the plentiful use of warm water, water gruel, chicken broth, and the like, and afterwards by allaying irritation by opiates. In the advanced stage of the disease, with a weak pulse and cold extremities, I have seen great advantage from the use of opium with aromaticks, as in the *confectio opiata*, and of musk in large doses. Every thing which has a tendency to vomit or purge actively, should be avoided ; but emollient glysters may be frequently employed. If, in the first stage of the disease, symptoms of fever and inflammation should occur, the patient may lose a considerable quantity of blood, and a large blister should be applied to the abdomen. In some cases, the warm bath may be employed with advantage ; it is, however, chiefly to diluents and opiates that we trust for a cure.

23. The secretion of bile is frequently increased and hurried by causes acting on the stomach, such as sea sickness, and emeticks ; the discharge of bile by vomiting is, therefore, no proof of its having existed in the stomach before the exhibition of the vomit, or of its having been the primary cause of nausea and indigestion : it is only the effect of direct action on that organ.

24. In the bilious feyer of the West Indies, the

nausea and vomiting, which arise from some slight degree of inflammation near the pylorus and upper surface of the duodenum, invite bile into the stomach, which has no tendency to produce the fever ; it is only an effect, and not the cause of the disease.

25. In warm climates, contagious and febrile poisons have a great tendency to act on the hepatic system, and hurry much the secretion of bile ; indeed, hemorrhages from the liver, accompanying the increased secretion of bile, frequently take place, and dissection generally shows congestion and a turgescent state of that organ ; this naturally suggests the use of active purgatives in those fevers, such as calomel, jalap, and the neutral salts ; indeed, so specifically has the liver been supposed affected in these cases, that some late writers on the subject of the contagious yellow fever now raging in the West Indies, have recommended the use of mercury in order to produce a salivation ; under which, we are assured, all the symptoms of malignancy have subsided.

CHAP. II.

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OF THE DIMINISHED SECRETION OF BILE.

Sect. 1. From what has been already observed on the use of bile and its application to the purposes of the animal economy, it is obvious, that a considerable diminution of the quantity secreted will be followed by disease. The liver may be rendered incapable of secreting the usual quantity of bile by any defect in its structure ; and that this is, frequently, the impeding cause, appears from dissection.

2. It is an organ very susceptible of chronick inflammation, which, without alarming in the first instance, by painful or active syptoms, gradually induces obstruction ; first, with an increase, and frequently afterwards a diminution of its bulk, perhaps ultimately obliterating the capillary system and

pori biliarii, the more immediate seat of secretion. In such cases the patient will be subject to occasional pain in the right hypochondrium, extending to the scapulae, a quick pulse, an increase of heat, alternating with chilly sensations, difficult breathing on quick motion, some difficulty on lying on the left side, flatulency, indigestion, acidity, costiveness, and, together with a gradual diminution of strength and flesh, the patient has a pale or sallow complexion. Such symptoms are accompanied with a defect in the secretion of bile, and a torpid state of the intestines.

3. It is probable, that under these circumstances, the original mischief is in the stomach and duodenum, and that the sympathetick action on the liver is less, on which perhaps healthy secretion may depend ; hence dispeptic complaints generally precede affections of the liver, and arise from intemperance either in eating or drinking, but are more particularly induced by the use of spiritous liquours, even though diluted with water. The stomach, by long fasting, has its digestive powers much weakened, by which the secretion of bile is diminished, and a diseased structure of the organ ultimately induced. Grief and anxiety of mind first weaken the powers of the stomach, and ultimately those of

the liver, and thereby diminish secretion : a sedentary life will do the same.

4. Hypochondriacal complaints are always attended with symptoms of dyspepsia and diminished secretion, and great torpor of the alimentary canal. In the chlorosis of women we have likewise a diminution in the quantity and activity of bile.

5. When the diminished secretion is preceded by affections of the stomach, such as loss of appetite, indigestion, and flatulent eructations, the diet of the patient should be attentively regulated ; and the art of cookery should be rendered merely subservient to digestion, and the preparation of healthy chyle. The quantity of food taken at any one time should be moderate, and water should be the only liquid drunk with our meals, as more effectually promoting digestion than fermented liquors of any kind. All raw or unboiled vegetables should be avoided ; ripe fruits may be moderately taken ; almost all boiled vegetables may be admitted. Animal food should be well boiled, or moderately roasted, and taken with its own gravy. Pye-crust, and every thing fried, should be excluded ; butter, rendered rancid by being melted should be likewise forbid. The patient should use moderate exercise, and drink some natural chalybeate water of a tepid heat, before breakfast, and perhaps in the evening. By

thus giving vigour and energy to the stomach and duodenum, the healthy action of the liver will be restored.

6. I am persuaded that the stomach digests solid aliment more easily than liquid and bulky food; and that soups and broths are more quickly disposed to run into active fermentation, and require the exertion of more vitality to restrain such morbid and spontaneous changes, than animal food in a solid form. During the period of our being awake, the stomach should have a supply of food, at least every six hours; the quantity in that case, would be more moderate at any one time, and would be proportionate to the demand of the system: the supply should be regular. Nor is there any good foundation for diversifying our meals; so that breakfast and dinner should be made up of different kinds of food. The secretion of bile would be thereby more regular, and the quality better preserved under such a regimen. A stomach, vitiated by bad habits, is with difficulty reformed, but may ultimately be reconciled to simple and healthy aliment. There are some stomachs which reject milk when it has been medicinally recommended; but they are such to which milk has been a perfect stranger; and in that, as in similar cases, small repeated quantities of it, taken without the mixture of any other kind of food,

have reconciled the stomach to any larger quantity, which may be thought necessary. The condition of the gastrick fluid, and the action of the stomach, accommodate themselves to that regimen, to which the stomach has been accustom'd.

7. There are some stomachs which are quick and powerful in finishing the process of digestion, and may require a greater and more frequent supply of aliment than others, whose powers are more limited; but in all cases the stomach should never be perfectly empty. A sense of uneasiness and acute-pain has proceeded from mere emptiness, under which, perhaps, the stomach may be said to feed upon itself: this occurs very frequently in delicate females; who, either from caprice or fashion, take in very small quantities of food at any one time, and yet whose meals are not more frequent than others of a more vigorous constitution. In such cases a meat breakfast, and a luncheon at noon, will prove the best remedies. I believe that chlorosis, atrophy, tubercle, and other glandular affections, would best be obviated by such a regimen, and females acquire more vigorous and active health by such a plan as is now recommended. With respect to the quality of our different meals, we seem to depart more from

the custom of our hardy ancestors, with regard to breakfast, than any other meal.*

A very leading symptom of a weak stomach, and an enervated constitution, is the loathing of food at breakfast; while a vigorous stomach discovers more energy in the morning than at any other time of the day. Digestion is best promoted by a state of rest after eating, and the exercise of the body is best adapted to restoring energy, and promoting the necessary secretions.†

6. The temporary loss of bile may be supplied by various bitters, occasionally united with rhubarb, aloes, and the like. The excess of acidity may be corrected by alkaline remedies and lime water. In infants the bile is frequently not sufficiently active,

* A Maid of Honour, at the Court of Queen Elizabeth, breakfasted upon beef, and drank ale after it;—while the Sportsman, and even the Day-labourer, now frequently breakfast upon tea.

† Dr. Harwood, the professor of Anatomy at Cambridge, took two pointers equally hungry, and equally well fed; the one he suffered to lie quiet after his meal, and the other he kept for above two hours in constant exercise. On returning home, he had them both killed. In the stomach of the dog that was quiet, and asleep, all the food was digested: but in the stomach of the other dog that process was scarcely begun.

and generally secreted in too small a quantity, which in them induces diseases of prevailing acidity.*

* We may observe farther, that the stomach, in its office of digestion, may derive assistance from the liver, by the latter counteracting some of those effects which arise from the diseased action of the former.

We know that when the powers of the stomach have been weakened, and when the digestive process consequently proceeds but slowly and weakly, there is often a considerable tendency to *ascendency* in the different parts of the primæ viæ. Different portions of the aliment, taken in, have a tendency to run into the acetous fermentation, when assisted by heat and moisture.

Thus we find many of the vegetables which we take into our stomachs, are digested with difficulty, and are very apt, in bad stomachs, to occasion symptoms of acidity. Flatulence and distention frequently succeed the taking of these substances into the stomach, and the gasses sent out from the mouth serve as an indication of what is going forward within. Cabbages, cauliflowers, peas beans, and the different farinaceous vegetables, are apt to produce this effect; whilst those substances which have no direct tendency to ascendency, may yet prove an indirect cause of it, by weakening the tone of the stomach, and thus disturbing the digestive and assimilating functions.

But there seems to be a power in a healthy stomach of counteracting those spontaneous changes which would take place out of the stomach, or in a diseased stomach. It is not, perhaps, too much to expect, from a vigorous stomach, that it should convert into good nutriment, every thing which contains materials ca-

7. In cases of diseased structure of the liver, producing a diminution of secretion, and particularly when such change of structure has arisen from in-

pable of forming a healthy chyle. Its powers may probably extend much farther than any trial yet made has discovered; and many circumstances, which custom has not yet introduced as articles of diet, may be very well managed by this organ. We find that it is capable of assimilating some substances, which are various and heterogeneous, and, therefore, it is fair to conclude, that it is equally capable of acting upon some which are more simple.

If, then, the stomach possesses a power, when in a healthy state, of counteracting the spontaneous changes which would take place in some substances out of the body, and will even prevent acescency in those which are disposed to produce it, if acescency does prevail, we must conclude, that it is owing to some diminution of the powers of the stomach. The question then to be answered is, "Can the liver contribute any thing towards the prevention of such an effect as this ?

It has been already proved, in the course of those experiments which have been before related, that there is in bile a resinous substance, in which reside the colouring principle and bitter taste. This bitter, resembling the vegetable bitter, has probably properties in common with that, and is capable of resisting the fermentation going on in the stomach, and alimentary canal, when any of its contents are disposed to run into this state. When it comes into contact with these substances, it may act as a chymical agent, and produce such a change upon them as shall prevent that process to which they are disposed.

flammation, mercury has been found useful, even carried to the degree of producing a slight salivation, moderating the violence, however, of its operation.

That this is the effect of the vegetable bitter on other occasions, constant experience evinces, in the use of hops, by which beer is prevented from proceeding so rapidly to the acetous fermentation.

The alkali, which is discovered as a constituent part of the bile, may serve to neutralize the acetic matter, when it prevails in too high a degree, and thus prevent any mischievous effects, which might arise from its continuance in that state, during its passage through other parts of the system. We are to remember that if this change does not take place till after it has passed from the stomach into the duodenum, it may still, in a secondary way, operate upon the stomach, upon that principle of sympathy which we have before referred to, as subsisting between different parts of the alimentary canal, or between the stomach and duodenum, or other small intestines.

Let us observe farther, that the mineral alkali which constitutes a part of healthy bile, may serve to neutralize the acetic matter when it prevails in too high a degree, and so prevent any mischievous effects which might arise from its continuance in that state, whilst it is passing through other parts of the system.

But not only to this acetic state of the contents of the primæ viæ, but also to that of *putrescency*, the bile offers a proper corrective. The foregoing experiments serve to prove the greater power which bile has of resisting putrefaction than the blood, without referring, at present, to the relative disposition to putrescency, betwixt the two fluids, we may

by plenliful dilution with gum arabick, and other vegetable demulcents.

In many cases where the liver and other abdominal viscera have been diseased, and in cases of glandular and mesenterick affection, attended with pain and tension, and even symtsoms of hectic fever, I have seen advantages from tepid bathing, the temperature of the water being 90 degrees of Fareahit's thermometer. The practice of tepid bathing may accompany the use of mercury, and other moderate dangerous exhalament which may sometimes arise from it.

8. Sea sickness, and a sea voyage, contribute very much to restore the secretion of healthy bile, so necessary to the welfare of the animal economy ; and symptoms of dyspepsia and diminished secretion, which are now rendered more conspicuous among females from their sedentary life, are most effectually removed by the means already suggested.

remark, that if the bitter property of bile have this tendency, this is a circumstance which at once explains the effect referred to. But when we consider that to preserve the general tone and vigour of the system is the best mode of obviating putrefcency, we may attribute this effect to the bile, which, by its immediate influence on the intestine, and its more remote influence on the general system, through the medium of the stomach, may produce it.

9. In some cases, the resistance of the secretion of bile may arise from the viscosity of the fluid obstructing the extremities of the common duct as it enters the duodenum : this will be removed most effectually by calomel, scammony, or jalap, which seem in their operation to stimulate and evacuate the duodenum, while many other purgatives act most forcibly on the large intestines.

10. In the infantile fever of children, so well described by Dr. Butter, a bilious diarrhoea comes on, which proves salutary and critical, and should be encouraged by a solution of sal. polycrest. in water, and sometimes by the occasional use of calomel and scammony, especially in the early stage of the disease.

11. There seems much sympathy between the brain and the liver ; and in maniacal persons, in whom there is generally a defect in the secretion of bile ; this evil is best removed by the means already recommended.

CHAP. III.

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OF OBSTRUCTION TO THE FREE PASSAGE OF BILE INTO THE DUODENUM.

Sect. 1. If, after bile is secreted, its free admission into the duodenum be impeded, so that an accumulation of it take place in the excretory ducts of the liver; it either regurgitates into the habit by the hepatic veins, or is absorbed by the lymphatic system; in either case it produces the diseases called JAUNDICE; the history and cure of which I shall now endeavour to explain.

2. JAUNDICE may be defined a yellow colour of the skin, and tunica conjunctiva of the eye, with urine of an obscure red, tinging linen with a yellow hue, and with the fæces generally of a light and clay-like appearance in consistence and colour.

3. This is a disease to which women are more subject than men, and adults than children ; though it takes place occasionally in persons of all ages and of both sexes. It is attended with a sense of lassitude and languor, a sense of pain and tension, or weight and oppression about the praecordia ; there is frequently much anxiety, and some degree of difficulty in breathing. The eyes and roots of the nails first become yellow, afterwards the whole body, which is also sometimes attended with an itching of the skin.—The disease is, often accompanied with nausea, vomiting, flatulency, acidity, and indigestion ; and the fæces, which are commonly of a white colour, have not the usual fæculent smell. Solid food generally tastes bitter in the mouth in some, and in the most unfavourable state of the disease there occurs hiccup, and occasional paroxysms of rigour, or chilliness. The pain is sometimes extremely acute in the right hypochondrium, or in the epigastrium. The state of the pulse varies ; in general it is quicker than natural, though in some cases, especially during the passage of a gall stone, it is slower. It very seldom or never happens, that objects appear to the patient of a yellow colour.

4. This disease is frequent during pregnancy, and in early infancy, in both, however, it is of a very short duration.

5. Its decline is marked by a gradual diminution of the sense of weight, oppression, or uneasiness about the praecordia ; a return of appetite and digestion ; the colour of the urine becomes more diluted ; it is secreted in a larger quantity ; the stools acquire a yellow colour, are more copious, and more easily procured ; sometimes hard and concrete matter is found in the s̄æces.

6. It is a disease into which a patient is very liable to relapse. It is very unfavourable, if the pain be violent and attended with a quick pulse, loss both of strength and flesh, with occasional chilliness, watchfulness, and melancholy ; under those circumstances, he becomes subject either to profuse sweating or haemorrhagy. When these symptoms attend it, the disease frequently terminates in a confirmed ascites.

7. Under such circumstances we may conclude, that though some bile must be secreted, and that its regurgitation, or absorption, is the consequence of some resistance to its free ingress into the duodenum ; yet that a part of the liver is, in its structure, or organization, materially diseased, a circumstance which, though frequently attendant on jaundice, is by no means necessary to constitute the disease.

8. On dissection, various appearances present themselves to our notice. The brain, the bones, and even the cartilages, are found deeply tinged of a yel-

low colour. The peri biliarii, and some of the larger branches of the hepatick ducts, are found sometimes obliterated by diseased structure. Gall-stones are often found in the *ductus communis*, but more frequently in the gall-bladder and cystick duct. In some a thickening and diseased structure of the *ductus communis* has taken place, not unlike what has been observed in the oesophagus or urethra. In many cases there have been appearances of mechanical pressure from the distention and tumour of surrounding and neighbouring parts, as of the pancreas, duodenum, and colon, either of a temporary or permanent nature; hence a jaundice may arise from pressure during pregnancy. The bile has been found of a very viscid, and pitchy consistence, especially in the gall-bladder, passing from the cystick to the common duct, and thereby perhaps resisting the passage of the more fluid hepatick bile, which would otherwise flow freely into the duodenum.

9. The *chlorosis*, to which young women are extremely subject, to a superficial observer, puts on the appearance of jaundice. In the chlorosis, the tunica conjunctiva is not more discoloured than any other part of the body, and the urine is not of a deep colour, but rather pale and limpid.—I am persuaded, however, that in the chlorotick habits the bile is more insipid, is secreted in less quantity, and of a

more pale colour than in health. This imperfect state is perhaps, in common to all the other secretions of chlorotick subjects, and may possibly arise from the watery state of the blood, the paucity of red particles, and the defective energy of the whole system.

10. In the endemic fever of the West Indies, in which the skin is obviously tinged with bile, there seems rather a redundancy of it in the primæ viæ, than a deficiency. Perhaps the quantity of bile which is secreted is so very considerable, that though the greatest part of it escapes into the primæ viæ, the whole may not readily find a passage ; and the surcharge thus occasioned may give rise to regurgitation and absorption. The reason for this may probably be, that the diameter of the common duct, or of the larger branches of the pori biliarii, though fully adequate to transmit the whole of the bile secreted in the healthy state of the liver, yet may be insufficient to convey the excess produced under an hurried and imperfect action of that organ ; and therefore with every appearance of a large supply of bile in the primæ viæ, a jaundice may take place.

11. The symptoms of pyrexia, and other phenomena of febrile miasmata acting on the body under this disease, the delirium, the quick prostration of strength, after early symptoms of local inflammation, either

in the duodenum, or region of the biliary ducts, distinguish it very readily from jaundice.

12. The secretory economy of the liver, in common with that of most other organs in the body, is very much under the dominion of the passions. Anger, it is well known, produces strongly marked effects ; it not only augments the quantity of bile secreted very considerably, but likewise vitiates it : hence it is, that by being carried into the duodenum in large quantities, and thence regurgitated into the stomach, it produces effects like those of an emetic.

13. If the *ductus communis* does not transmit it as fast as it is secreted, and the gall-bladder is so full that it cannot receive the excess ; then it will be forcibly returned upon the hepatick system, and by entering the blood vessels produce jaundice.

14. It seldom happens, when a secretion is hurried by the excess of action, that the fluid secreted possesses its natural and healthy properties ; hence arises the variation in appearance of bile, which, in some acute cases, as in cholera morbus, I have seen of a colour as black as soot, so as to resemble more the red particles of the blood, in a broken or a diseased state, than the bile. Such a fluid may be considered as something between blood and bile, and carried off so quickly, that the process of making bile had only just begun, though the change in the

condition of the blood with a view to that process had taken place. This could not have depended on any diseased structure, for it is instantly removed by opiates and other means which may restrain immoderate action.

15. Men engaged in literary pursuits, and women, from leading sedentary lives, are very much disposed to jaundice and other diseases of the abdominal viscera ; for the excretory powers of the liver depend but little upon any action which the biliary ducts can perform, as they possess a very small degree of irritability ; but are assisted principally from the agency of the diaphragm, abdominal muscles, and peristaltick motion of the intestines ; and more especially from the agitation which the hepatick system suffers during bodily exercise. The want therefore of a degree of exercise sufficient to assist the biliary ducts in their excretory function, must necessarily lay an ample foundation for morbid affections. And the necessity of this external aid to the perfect action of the liver, seems more obvious from the circumstances of its venous circulation, which is always more languid than in those secretory organs where the fluids are kept in a state of more rapid motion by arterial impulse. Horse exercise seems particularly well calculated to assist the action of the abdom-

inal viscera, in cases of defective excitement in the hepatick system.

16. The bile, during its stay in the gall-bladder, acquires a vici'd consistence, perhaps, in some measure from the absorption of its more aqueous parts, and likewise from a propensity to spontanenus separation, by which its coagulable part may detach itself. Though this circumstance is less obvious in bile than in blood, and though it may require more time to be effected, yet I think it probable, from analogy, that such a separation of its parts may take place.

17. In many cases we find the abuse of spiritous liquors disposes to jaundice, evidently of the most unfavourable kind ; because generally accompanied with diseased structure. They may act by first altering the structure of the stomach and duodenum, and afterwards by sympathy of contiguity, affect the biliary ducts of the liver. In the dissection of those who have been intemperate dram-drinkers, the diseased structure may be traced from the stomach along the course of the ductus communis, and I have frequently seen these ducts so contracted and thickened, that they could not transmit bile.*

* I was informed by the late Mr. Hunter, that the stomachs of dram-drinkers are generally found in a flabby and inelastic state, capable of secreting only diseased fluids : this loss of tone in the stomach is followed by frequent vomiting, tremulous.

18. However remotely situated some parts of the body may be from others ; yet a diseased action is quickly propagated to a distance, without affecting intermediate parts : and it frequently happens, that an attempt to cure the disease of a part, is followed only by its removal to some other organ of the body ; hence the suppression of issues, cutaneous eruptions, and haemorrhoids, are followed, in some cases, by morbid affections of the lungs, in others of the hepatick system, and those do not always subside on restoring the diseased action to the organ first affected. In confirmation of this opinion, I have seen a jaundice with a sense of pain and oppression on the right hypochondrium, correspond and alternate with piles, and habitual discharges of pus in the lower extremities.

19. It is generally admitted, and I think sufficiently proved by some experiments already men-

motions of the muscles, propensity to palsy, and loss of memory. — In many cases as has been already observed, the liver is so far diseased, that it does not even secrete bile, and a pallid and unhealthy aspect takes place.

The urine is secreted in a small quantity, of a deep colour, though not tinging linen of a yellow hue. This is frequently a more dangerous state of disease than jaundice, which indicates only a resistance to the passage of bile into the duodenum, and may take place in the most healthy state of the liver.

tioned, that the biliary ducts are very passive, that they submit very easily to mechanical distension from calculi, without contracting afterwards like sensible or irritable parts ; therefore when jaundice has arisen from very acid emetics, or griping purgatives, or colick, or hysteria, the resistance to the free passage of bile is either at the very extremity of the *ductus communis*, or during its oblique course through the substance of the duodenum, at which part it is liable to compression from the muscular action of that intestine. And perhaps, likewise, the increase of the quantity of bile in the intestine, may depend on an action communicated to the *ductus communis*. In the one case the duct may be closed, in the other it may be acted upon by successive motions, by which it emulgates more quickly its contents.

20. When we were treating of the natural and chymical history of the bile, we annexed some observations on the appearances and component parts of biliary calculi, which will supersede the necessity of a repetition of them in this place. It will be proper here, however, to remark, that such concretions do not occur in every part of the biliary system with equal frequency ; from dissection it appears that they very rarely exist in the hepatick ducts, sometimes met with in the *ductus communis*, more frequently in the *ductus cysticus*, and are most com-

mon in the gall-bladder. The bile accompanying them is more vicid than usual, and appears to contain a larger portion of the colouring and bitter principles.

21. The number and size of these calculi vary much : sometimes the gall-bladder is filled with them, at others there are not more than one or two ; sometimes they are small and angular, at others large, and have a more regular surface. I have seen a gall-stone nearly the size and figure of the gall-bladder itself, so as nearly to fill the whole cavity. These large calculi are less frequently the cause of jaundice than smaller ones : for, from their bulk, there is but little probability of entering the ductus cysticus, and afterwards of obstructing the ductus communis. It is from the calculi of smaller dimensions that such obstructions are occasioned. However the rule is not without exceptions, and from dissection it appears, that calculi of considerable bulk must have passed, for the ductus communis has been enlarged to an inch in diameter, an instance of which has been met with by Dr. Heberden.

22. But calculi have passed, during life, of such a bulk as to occasion a doubt whether they escaped into the intestines by the natural canals, or made their way thither by a preternatural passage. Dr. Cheston, some years ago, met with a case where a

gall-stone of an unusual magnitude passed during life, and the patient got well. Some years after she died of another complaint, and on examination it appeared that this large gall-stone had made a preternatural passage through the gall-bladder into the intestine. Mr. Cline, in his excellent collection of anatomical preparations at St. Thomas's Hospital, has an instance of a case of this kind.

23. A permanent jaundice has frequently arisen from surrounding tumours compressing the hepatic ducts : a schirrous enlargement of the pancreas, has sometimes produced this effect. Excessive vomiting, and violent exercise, perhaps by forcing stones from the gall-bladder into the cystick duct, and from thence into the common duct, have produced the disease. There is an instance where jaundice arose from the seeds of goosberries being found in the extremity of the *ductus communis* as it enters the duodenum. In short, whatever can obstruct or impede the passage of the bile into the duodenum, must be considered as a cause sufficient to produce jaundice : but in what way the bile passes from the biliary vessels into the general circulation, has already been explained in the physiological part of this work.

24. The jaundice when arising from a diseased state of the structure of the liver, or from the tumour.

of surrounding parts, and more especially if accompanied with fever and gradual diminution of strength and flesh, is seldom cured, and generally terminates in ascites.

25. If, on the other hand, it has arisen suddenly in young and vigorous habits (though accompanied even with much pain) unattended with fever and the other unfavourable circumstances above remarked, it is seldom of long duration, and by a judicious treatment may be effectually removed.

26. The *cure of jaundice* consists in the removal of exciting causes, and in alleviating urgent symptoms. Calculi are the most frequent exciting causes.

27. It appears from experiments that some calculi are soluble in an alkali, in spirit of wine, and oil of turpentine; but it is altogether impracticable to make a direct application of those substances to calculi in the biliary ducts, as we have no facts to prove, that by the course of circulation, they can be carried into the gall-bladder so little changed as to preserve any sensible degree of power. It remains yet to be proved, that the proportion of alkali in the bile is increased by alkaline remedies.

28. Many saline remedies pass into the urine unchanged, and may act on calculi in the bladder; but we cannot detect the presence of alkaline or other solvents in the bile. The analogy, therefore, be-

tween the action of solvents in biliary and urinary calculi will not obtain.

29. The passage of gall-stones may be promoted by gentle vomits, and for this purpose, ipecacuanha may be given ; but its action will be assisted if it be exhibited in small and divided doses, so as to occasion, for a time, a degree of nausea, but ultimately to produce the full effect of an emetick. And, perhaps, it is on this principle that sea-sickness, in those cases has been so very efficacious.

30. The duodenum may be stimulated by calomel combined with scammony or rhubarb, and in cases of the defect of bile in the internal canal, the deficiency may be supplied with a purgative bitter, by an infusion of camomile flowers, with tinct. aloes, or columba, with rhubarb and soap, or kali vitriol. with infus. rhei. In cases of violent pain, with a slow pulse, opiates and tepid bathing may be recommended. In cases of pyrexia, with local pain and dyspnoea, venæ fæctio and the antiphlogistick regimen may be used with advantage.

31. Gentle exercise on horseback is particularly useful in promoting the passage of calculi, and preventing the stagnation of bile in the gall-bladder, which probably renders it vicid, and liable to obstruct the free passage into the duodenum.

32. In jaundice from tumour or pressure of surrounding parts, small doses of calomel, or some other mercurial preparation, may be useful, unless symptomatick fever should take place, in which case mercury is hurtful. Chalybeate waters may be used to advantage with a view of giving tone and energy to the system, so very defective in cases of jaundice.*

* Mr. Dick, a gentleman high in the professional line, in Bengal, and of much practice in Calcutta, in a letter to me, says,—“ I have been for the last seven years in the habit of giving calomel in the jaundice, in doses from two to five grains every night, till the mouth was affected, and in every case the jaundice went off as soon as the mouth became sore. I now scarcely use any other medicine, except merely to prevent costiveness.—I cured upwards of forty patients in that way, and all in less than a month, generally in ten days, or a fortnight.”—The same gentleman, in a subsequent letter to a friend, after paying many compliments to my Treatise on the Liver, says,—“ I think, however, that Dr. S. has not so high an opinion of the good effects of mercury, in liver complaints, as it deserves. I have been confirmed more and more by late practice, in my opinion, of its effects in the jaundice, though I do not attempt to reason upon it.

“ In recent attacks of liver complaints, after early bleeding, blistering and the free use of laxatives, I never saw a case where suppuration came on, if mercury was freely used and continued till the mouth was sore ; and, if I be not much mistaken, it is in such cases that it has the best ef-

" fe&ts.—In chronick cases, where there is no fever,
" but only an obtuse pain in the side and shoulder,
" with a fullness in the side, and about the pit of the
" Stomach, keeping up a constant uneasiness, mer-
" cury seems to me to have but little good effects :
" when used freely it removes the symptoms at the
" time, but they generally return as soon as the
" mercury is left off. Having been repeatedly bas-
" sed in this way, and observing very often that
" such liver attacks succeed long courses of mercury,
" undergone for the cure of venereal complaints, I
" have for several years past trusted to a feton or if-
" sue made in the side, and with success far beyond
" my expectations."

These being the remarks of a gentleman of much practice and observation, I have given them in his own words, being convinced that they deserve the particular attention of those who practice in India,

CHAP. IV.

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OF THE DISEASES TO WHICH THE LIVER IS SUBJECT IN COMMON WITH OTHER ORGANS OF A GLANDULAR STRUCTURE.

Sect. 1. The liver is susceptible both of acute and chronick inflammation ; perhaps of the former, as being more immediately connected with arterial or nutrient, the latter with its venous or secretory system. When the liver is seized with acute inflammation, the disease is called Hepatitis.

2. It is generally preceded by some degree of *horripulatio* and *rigour*, which in some cases however, are so slight as to evade the attention or recollection of the patient ; to these succeed an increase of heat and quickness of pulse. The pain in the right *hypochondrium*, or region of the liver, is very acute, attended with difficult and painful respiration, great

watchfulness, and occasional delirium. The patient lies with more ease on the right side. The urine is secreted in small quantity, is high coloured, and frequently tinged with bile. The tongue is generally covered with a white crust, and, together with the mouth and *fauces*, is extremely dry. These are the leading symptoms of Hepatitis.

3. The symptoms are somewhat varied, according to the particular part of the liver which may happen to be the seat of the disease. If the inflammation attack the vortex surface of the liver, so that the peritoneum becomes affected, the pain is much increased by external pressure, and some degree of *tumour* may be observed. If that part of the organ be diseased which is more immediately contiguous to the diaphragm, it gives rise to difficult and painful respiration, dry and frequent cough, acute shooting pains in the thorax, extending to the humerus, clavicle, and scapula.

4. These symptoms, from the resemblance they bear to those of pleurisy, peripneumony, and other inflammatory affections of the chest, are apt to mislead an unwary practitioner ; but are to be distinguished from them by an attention to the history and progress of the complaint.

5. In some cases of Hepatitis the stomach is so extremely irritable, that violent retching or vomiting.

occur, symptoms influenced perhaps, by the inflammation being in the vicinity of that organ. In most cases the secretion of bile is increased under active inflammation, though its passage into the *duodenum*, is frequently impeded, so that jaundice is no uncommon symptom of this disease.

6. If the symptoms of *fever* and local pain continue to increase rapidly for a few days, a suppuration takes place, a large quantity of pus is formed, the external tumour becomes more prominent, a fluctuation may be perceived, so as successfully to direct the operation of the surgeon to an artificial opening by the caustick or the lancet. During the formation of pus frequent rigours are felt, and a sense of weight and oppression succeeds that of acute pain.

7. It frequently happens that *pus* is formed either in the vicinity of the *ducts*, or in the concave part of the liver; so that no external tumour can be perceived. The usual symptoms of suppuration, however, may be observed in all cases where matter is produced; and if the outlet to it be free and open by the intestines, the patient frequently recovers, even after being much emaciated, and under appearances extremely unpromising. If again, on the other hand, the pus is discharged either through the *diaphragm* into the cavity of the thorax, or more directly into that of the abdomen, the disease generally proves fatal.

8. With respect to the manner in which the discharge is effected in those cases where it passes off by the intestines, it must be clear that some of the branches of the hepatick duct are involved in the suppuration, and consequently destroyed by the ulcerative process.

9. We should then naturally suspect that the pus would insinuate itself into those orifices of the hepatick ducts, which ulceration had formed, and by those channels make its way into the duodenum.— But this explanation is unattended with difficulty : for it must be recollect'd, that wherever suppuration and ulceration are going forward, there adhesion is an attendant.

10. It would be departing from the main object of this work to branch off into a digressive inquiry on the advantages resulting to the machine from this connexion of inflammatory stages, as those advantages are as much diversified as the parts which are the seat of inflammation. It is in place here, however, to observe, that an abscess of the liver, in common with other parts, has its boundaries circumscribed by the effusion of coagulable lymph so changed by passing through inflamed vessels, that the parietes of that abscess become soldered into a solid compact mass. Thus an abscess which, under contrary circumstances, would have diffus'd itself to an indef-

nite extent, now becomes determined and circumscribed.

11. These considerations prepare us for a change, which must necessarily be induced on the ulcerated branches of the hepatick duct; the coagulable lymph, which is every where poured out upon the internal surface of the abscesses, will, in all probability, so obstruct the ulcerated orifices of the biliary ducts, that no pus can make its way by them into the intestines.

12. Notwithstanding this, I think it very probable that an abscess may point on the concave surface of the liver, and so far involve the hepatick duct, that it may ulcerate through its coats, and allow the matter to pass into the duodenum. Whether we may be able to distinguish such a case in the living subject is rather doubtful; but I should suspect that the discharge of pus by the intestines will be very gradual, as the opening of communication is rather small.

13. Perhaps the most useful evacuation of hepatick abscesses by the intestinal canal is that where an adhesion takes place between the suppurating part and the intestines, an ulceration ensues, and the contents of the abscess have a ready passage into the intestines. This may happen in different parts of the intestinal canal, according to the situation of the

abscess.—When it is seated at the concave part, the duodenum may be favourable for that purpose ; but when the lower edge of the liver is the part concerned, the great arch of the colon is the usual outlet ; and in these cases it is highly probable, from the scale of the parts concerned, that the opening of communication will be more extensive, and the discharge of the matter more free.*

14. The diseases which are mistaken for hepatitis are peripneumony, inflammation of the stomach, and rheumatick affections of the muscles in the neighbouring parts.

15. The hepatitis is less easily distinguished from peripneumony when that part of the liver is affected which is seated within the false ribs, where it enlarges itself into such a direction as to make a pressure on the diaphragm sufficient to diminish the cavity of the chest : and it is probable, likewise, that from the extension of the inflammation into the substance of that organ, its operation as an instrument of respiration may be much impeded.—Under these circum-

* This view of the complaint accords generally with that of my friend Dr. Cheston, who favoured the world with his thoughts on this subject many years ago, in his publication called Pathological Inquiries and Observations, a work not less distinguishable for the accuracy of observation than valuable for the judicious remarks it contains.

stances a troublesome cough, with difficulty of breathing, comes on ; so that the disease assumes the appearance of thoracick inflammation.

16. It is more easily distinguished from the inflamed condition of the stomach, by its not being accompanied with that extreme sense of heat and pain with which that organ is affected, especially after taking any thing into it ; nor is the debility of the system so great in the inflammation of the liver as in that of the stomach.

17. In the case of muscular pain there is little or no fever ; the pain is more diffused, is frequently removing from place to place, and is more influenced by varying the posture of the body : it generally alternates with rheumatick pain in one or more joints of the body.

18. When the hepatitis terminates spontaneously and favourably, there is some evacuation by haemorrhagy, diarrhoea, perspiration, or a copious sediment in the urine. In some cases I have seen a great increase of bronchial secretion accompanying the resolution of this disease ; and it is not improbable but that a superficial discharge of coagulable lymph may promote this resolution, though afterwards productive of adhesive inflammation.

19. It has frequently happened that a large abscess has very quickly formed, which, either by

corroding the large blood vessels, or by effusing pus into the general cavity of the abdomen, has proved fatal.

20. Symptoms, indicating the formation of matter in the substance of the liver, have sometimes suddenly ceased ; so that either a translation of the disease to some other organ has taken place, or pus has either been quickly absorbed, and been discharged by urine.

21. The period of suppuration varies according to the degree of inflammation, temperament of the patient, nature of the climate, season of the year, or the means of cure which have been adopted.

22. The symptoms of suppuration are not always, however, very obvious ; the most striking of them are, a diminution of pain, a sense of pulsation, and of weight in the right hypochondrium, especially when lying on the left side, frequently returning rigours, an accession of fever towards the evening, with flushings of the countenance, a propensity to profuse sweating, and other symptoms of hectic fever. In many cases the fluctuation is very apparent. I have seen some cases where the pain and inflammation have subsided very suddenly, and been succeeded by a very low, fluttering pulse, cold extremities, delirium, and death : so that there has been reason to suspect that this organ.

may on some occasions, though much less frequently than others, become gangrenous.

23. The hepatitis frequently terminates in the enlarged and seirrous state of the organ ; and we may observe on the inspection of dead bodies, such a variety in the appearances, as to suggest the idea of different kinds of seirrous affection, which will be best explained by attending to the progress of chronick inflammation in the liver, to which species it is more subject than to the acute. It is indeed sufficiently evident from dissection, that the liver is subject to inflammation, which did not obviously appear from any prevailing symptom before death : though perhaps a more accurate attention to circumstances might have ascertained the disease.*

24. From repeated observations I am induced to believe that the chronick inflammation of the liver is frequently mistaken for a dyspeptick state of the stomach. And I have seen many cases of this kind, which have been supposed to arise from indigestion. The patient generally complains of pain, which he falsely attributes to the stomach ; and its continu-

* For a more particular account of the diseased structure of the liver, the reader may consult the Morbid Anatomy of the Human Body, by Dr. Bailie ; a most excellent and useful book.

ance is so short, and the degree of it frequently so inconsiderable, that no alarm respecting the future health of the patient is produced. The relief obtained by eructation and discharge of air tends to confirm the opinion that the seat of the disease is in the stomach; but this relief may be explained on the principle of removing the distention of the stomach, and so taking off the pressure of this organ from that which we believe to be the seat of the disease. I believe from experience, that an attention to the following circumstances will enable us with some certainty to distinguish the disease.

25. In those cases where the liver is affected, considerable pain is felt in the parts near the scrobiculus cordis and epigastric region, upon any degree of pressure; and as the disease advances, an increase of heat, a quickness of pulse, and other symptoms of fever, are observed, especially towards night. The patient will sometimes derive relief from bleeding at the arm, and the blood when drawn, will put on those appearances which are common to febrile complaints and disorders of an inflammatory nature.

26. The acute inflammation of the liver is an endemic disease in warm climates, more particularly in the East Indies, and very generally terminates in suppuration. When the symptoms of active inflammation, however, have been checked, though not ef-

fectually removed, by the antiphagistick practice, the disease frequently becomes chronick, and terminates in a schirrous induration of the organ.

27. On this subject much information may be obtained by observing the countenance of the patient, which, though not wearing the appearance of jaundice, yet has a peculiar sallowness, expressive of a morbid condition of the liver.

28. The two complaints are not more distinguished by their symptoms than they are by the different states of the liver which produce them.

29. In chronick inflammation, a condition obtains in some degree the reverse of the former. Instead of appearances which accompany and characterise acute and active inflammation, there are manifest signs of indolence and want of action in the circulating system. The colour natural to this organ in the healthy state, and which appears to be imparted to it from the bile, is lost ; it assumes an ash or clay-coloured hue, evidently connected with a diminished secretion.

30. This kind of liver is obviously smaller, it undergoes a change in shape ; the lower edge, which is naturally thin, especially of the left lobe, becomes rounded and gibbous.

31. If we cut into its substance, we find uniformly a solid compact appearance, interspersed with

foramina, evidently the orifices of divided vessels ; but if we compare the surface of a diseased liver with that of a healthy one, we observe a very sensible difference, the latter being much more porous than the former. This morbid and compact state, together with the diminished bulk of this organ, lead us at first view to a suspicion that the diminished size may be explained on the principle of consolidation of its substance ; or, in other words, that it has gained in compactness what it has lost in external bulk.

32. If this explanation were just and adequate, we should find the liver of its natural weight ; but observation has evinced that, together with a diminution of bulk, there is some degree of loss in its weight, evidently proving that a portion of its solid substance has been removed, and carried into the general mass of fluids, agreeably to a law of the absorbent system.

33. But I strongly suspect that this diminution of substance obtains in different degrees, according to the period or duration of the complaint. In the more early stages of schirrccity the liver is not sensibly diminished in its bulk : nay, I am persuaded that there is at this period an increase both of bulk and weight, but that afterwards there is a gradual diminution of both ; and this is

nothing more than may be expected when we consider the causes that occasion this disease.

34. These causes are of a nature which tend to produce a hurried, and consequently an imperfect secretion of bile, viz. long residence in a warm climate, and the immoderate use of ardent spirits.

35. But, whatever be the remote or occasional causes, it must be evident that the immediate causes can admit but of little variety. To produce an increased secretion of bile, it must be evident that there must be an increased action of the branches of the vena portarum, and an accelerated circulation of fluids through those branches: hence a condition of vessels is induced, approaching in some respects to that of inflammation, with this difference, that it is an inflammation in which the vein, or secreting vessel, is more concerned than the artery or nutrient vessel.

36. The effect of this action, especially when protracted to considerable extent, must necessarily be that of inducing an alteration in the structure of the part—an alteration similar to what obtains in other organs labouring under indolent and chronick inflammation.

37. This change of structure, from its solidity and compactness, seems to depend on the effusion of the coagulable lymph into the parenchymatous substance

of the liver, with the peculiarity, that while it is, in active inflammations, deposited by arteries, it is, in the chronick kind, effused by the veins.

38. Thus we are in possession of a cause which appears to offer an explanation of that diminished secretion of bile usually met with in such cases, where a hurried or excessive secretion was wont to prevail : but to proceed any further in this train of reasoning would be to anticipate what we have to propose on the subject of the proximate cause.

29. If the position just stated be true, it must be admitted as a consequence, that such livers are not performing their full share of that office in the machine to which they were destined by nature.

40. Now we know, that by a law of the absorbtion system, such parts as cease to perform the office nature intended they should do, are considered as useless bodies, and are fit subjects for the action of these vessels : hence it is that there is, a greater diminution of substance in those schirrosities which are of long standing, than in such as are of more recent date.

41. To inquire in what consists the proximate cause of inflammation of the liver, is to investigate what is the proximate cause of inflammation in general.—The limits prescribed to this work do not allow us to enter extensively into this question, as it

would involve an examination of the prevailing theories on this subject.

42. From observation we are taught the means that are used with advantage to palliate and even to remove inflammation ; and from observation likewise we learn, that the same means which are serviceable in one inflammation are injurious in another : now, admitting the axiom, " that similar causes produce similar effects under similar circumstances," and finding likewise that some inflammations are aggravated by the very means which cure others ; we infer as a consequence, that the condition of inflamed vessels, or, in other words, the proximate cause of those symptoms denominated inflammation, is not always the same. Hence arises a considerable share of the difficulty attending the investigation of proximate causes in general.

43. The phenomena of inflammation evidently show, that in every inflamed part there is a congestion of blood, in a greater or less degree. This is very conspicuous in those parts of the body where, from their situation we are enabled to see the change of colour, as in the skin ; but more especially the tunica conjunctiva of the eye, where, from its transparency, and the white subjacent tunica albuginea,

we have an opportunity of seeing clearly the commencement and progress of inflammation.

44. The first appearance is a distention of some of its vessels in such a degree, as to allow red blood to pass where serum only was wont to circulate. In the progress of inflammation more vessels become distended, until at length the whole eye assumes almost one uniform red appearance

45. Now on what peculiar state of vessels does this distention depend ? Are the powers that act in propelling the blood from the larger vessels to the smaller ones increased, while the resisting powers of the ultimate branches remain the same as in health ? Or have the ultimate branches undergone a change of such a nature as to yield the ordinary force or natural *vis a tergo* of the larger vessels ?

46. There are good reasons for believing that each of these conditions exists in its turn : at least, the methods employed with success to remove inflammations of this part lead to that opinion. For it is a fact well established in the treatment of these complaints, that the same means which are employed in the cure of one ophthalmia tend only to aggravate another. The means generally employed in these cases are such as either diminish action or increase tone ; and each plan of treatment is successful in its proper case.

47. Now what has been said of ophthalmia will apply to hepatitis and other inflammation.

The liver may be inflamed in consequence of external injury. In such cases it is probable that a violent and strong action will take place, analogous to what would happen in the eye from the presence of an extraneous body ; and that a plan of treatment evidently sedative or antiphlogistic is most likely to be efficacious in both.

48. On the other hand, the same organs may be in a state of inflammation without the application of any obvious stimulating cause. In the eye, experience has evinced that this kind of ophthalmia is most successfully treated by bark, and such external applications as tend to stimulate and give tone ; evidently showing that the essential character of that inflammation is debility. And further, it is now well understood that an inflammation of the eye, which was of the active kind at its commencement, changes in its progress to a state of debility, and yields only to those means that give tone and strength to the part.

49. It is of importance to our subject to investigate in what way an active inflammation degenerates into an indolent one.

We have said, in every inflammation, there is some degree of congestion of blood, and consequent-

ly distention of vessels : if this congestion be relieved at its commencement, by lessening the distending cause, the vessels, still preserving their tone, readily return to their original dimensions : but if, on the other hand, the congestion is allowed to remain, and of course the distention of the vessels, their tonick power necessarily becomes diminished, and such means only can avail, as tend to lessen the column of the blood, and increase the contractile power of its vessels.

These reasonings may serve to give some idea of the two states of the vessels as connected with active and indolent inflammation.

50. As the principles laid down apply to inflammations of any organ, we shall endeavour to show, by considering the nature of remote causes, in what way they may produce this state of vessels in hepatitis.

51. Many remote causes of hepatitis may be enumerated, such as affections of the mind, particularly anger, long protracted summer heat, the intemperate use of spirituous liquors, &c. But to produce the same disease it is natural to expect that there is one principle of action in common to them all. This principle appears to consist in inducing a state of excitement in the circulation of the liver : the accelerated, though imperfect, secretion of bile, to-

gether with the sense of fulness in the region of the liver antecedent to inflammation, tend to persuade us that hepatitis is generally ushered in by symptoms of existing congestion.

52. If proper methods be taken to relieve this congestion on its first attack, such as diminishing the column of blood or inducing a determination of it to contiguous parts, the tone of the vessels will be preserved, and evident inflammation prevented. Or even if an obvious inflammation has commenced, the same means will be equally serviceable by allowing the distended vessels to recover that tone which they were beginning to lose. But if the congestion has been of some duration, and the tonic state of the vessels considerably impaired, if the most active means are not employed, the consequence will be either a suppuration, if the inflammation be violent, or a degeneracy into schirrus, if the inflammation has been moderate: and it is in this way, I conceive, that an inflammation of the liver, which was of the active kind at its commencement, changes in its progress into a state of schirrosity.

53. Or, a state of schirrus may be gradually induced on the liver, without any pre-existing active inflammation, as happens after a long residence in a warm climate, where, from frequent accelerated:

secretion of bile, the hepatic vessels, but more especially the branches of the vena portarum, become so relaxed, that they effuse into the parenchymatous substance of the liver that solid matter, which appears to be nothing more than the coagulable lymph of the blood changed in a peculiar way.* This is the morbid structure of the liver, which generally terminates in ascites.

* Dropsy is a very general consequence of a diseased liver; which, from previous inflammation, may have suffered in its structure in such a way as to produce a considerable impediment to the transmission of blood by the vena portarum.

Such dropsies sometimes first manifest themselves by water in the abdomen, at others by a fluid in the cellular membrane. Now, as both of these originate from the same cause, it may deserve inquiry, to what circumstances we should impute this apparent want of uniformity in nature.

This explanation must be sought for in the laws of the circulation. Whatever share a diminished action of the absorbent system may have in producing an accumulation of watery fluids, it must be evident that a considerable degree of effusion from the exhalent system is essentially necessary, and which excess of effusion can arise only from an excess of vascular action.

Admitting this position, it must follow as a consequence, that when the action of the whole exhalent system of the body is increased, the effusion, which is the effect of it, must be as extensive as the cause: and on the contrary, when the accelerated action is confined to a part, the effusion must like-

54. But there is an appearance sometimes met with on dissection that is perhaps a little difficult to explain on this system of reasoning—this is a tubercular state of the substance of this organ, consisting

wise be equally limited. Now are there any causes to which we can refer this extensive or limited affection? As all accelerated action is to be referred to stimuli of some description, we naturally inquire how that condition of vessels can be produced sometimes in the whole exhalent system, sometimes in a part.

From established laws in the vascular system, it is clear, that whatever can impede the free passage of the blood from the venous system to the right side of the heart, or from the right side of the heart to the left, will operate as a stimulating cause, and produce effects on the exhalent system, either limited or extensive.

To satisfy ourselves respecting this point, we need only compress a principal vein either of the upper or lower extremity, at the same time allowing the artery to remain free. The effect of this experiment will be, that the veins below the pressed part immediately become distended, the limb sometime after becomes enlarged, and if pressed upon with the finger, is proved to be evidently in a state of oedema.

Let us inquire what operations have taken place to which we can refer these effects—It is evident, that the return of venous blood was first impeded by pressure, and that a resistance was formed to the action of the arteries, the ordinary efforts of which are now become insufficient to propel the blood with its wonted velocity; hence a necessity for greater exertion of the arterial system to surmount the diffi-

of a series of circumscribed inflammations, interspersed through the apparent healthy substance of it. Now it may seem a little difficult to understand how an accelerated circulation through the whole sub-

culty : but as the exhalents form a part of this system, and partake of the general effect, an effusion of their watery contents follows as a consequence ; hence the œdema, or in other words, a local dropsy.

The production of the effect just stated does not argue or suppose any previous disease either in the exhalents or absorbents, but arises from the concurring operation of two causes, (viz.) an impediment to the return of venous blood. and the consequent accelerated action of the capillary and exhalent systems. And it ought further to be remarked, that as the remote cause was limited to a particular part of the body, so was the effect produced by it.

Let us now transfer this reasoning to the liver, and see how far an impediment to the free passage of blood, through that organ, may operate towards the production of ascites.

That state of the liver, which more particularly disposes to this disease, is the schirrous or indurated one :—that, which when examined by making slices of it, manifests a solid and close compacted mass, as if there had been deposited interstitially within its substance, solid matter sufficient to destroy its parenchymatous character. Indeed the fact seems very evident, that its vessels are less pervious, and consequently that the blood cannot be transmitted by them so freely as in a state of health.

Now in a former part of this work we endeavoured to make it probable, that the indurated or schirrous condition of the liver depended more on a

stance of the liver can produce effects so partial and circumscribed. But the difficulty is no greater in this case than in any other of local inflammation. Do we not continually see instances of circumscribed

diseased action of the vena portarum, than of the arterial system of this gland; and that when an inflammation arose in this way, it was to be regarded rather as of the passive than of the active kind; or a species but little disposed to terminate in suppuration. Its effects are rather those that characterize indolent parts, such as induration, schirrofity, &c. But this consequence necessarily ensues, that though venous inflammation has not activity enough to produce pus, it has power to effuse the coagulable lymph of the blood into the interstitial parts of the liver, and thereby diminish the capacities of the blood vessels, more especially of the vena portarum: and thus an impediment to the free passage of blood through that system is formed.

Having thus shown the probability of an obstruction existing to the passage of the blood through the liver, in what manner does this bear a resemblance to the effects of a ligature on the principal vein of an extremity?

Before we can answer this question, we must recall to the attention of our readers what has been said in a former part of this work on the subject, relative to the circulation of blood through the chylopoietick organs. There it was remarked, that the blood which had circulated through the stomach and intestines, omentum, spleen and pancreas, and we may likewise add the peritoneal covering of these viscera, was returned to the heart by the intervention of the vena portarum of the liver: there-

inflammations and abscesses where the state of the circumjacent parts is natural and healthy? Such phenomena do not tend to disprove the principles we wish to establish, but show that the diseased condition of vesicles we have before pointed at, may exist in a number of small parts of any organ, while the greater part of its bulk shall be in a natural state; or that there may exist a considerable number of stimulating causes in the substance of the liver, each having its own sphere of action, and each limited in its extent.

fore it follows, that the circulation of blood through this viscous stands in the same relation to the peritoneal viscera as the returning blood in the principal vein of an extremity does to that particular limb; and likewise it must follow of necessity, that whenever the liver is affected with any considerable degree of schirrosis, the circulation through the vena portarum will receive some interruption. That interruption, in whatever degree it may exist, must excite the capillary vessels and exhalants in the peritoneal viscera to greater actions; and the effusion of lymph from those parts follows as a consequence. Such appears to me to be a rational explanation of ascites, as founded on a schirrous affection of the liver.

On the same principle may be explained the hydrothorax, as originating in the excitement of inflammation in the cavity of the chest; or in any mechanical obstacle to the free passage of blood from one side of the heart to the other, or from the pressure on the diaphragm arising from an enlarged liver, or an ascitic dropsy.

55. The explanation just given is not offered as the mere suggestion of theory, but admits of a degree of probability approaching to demonstration. This last opinion seems strongly supported by the result of an experiment that was made for the purpose of investigating a point in physiology, not connected with the present question.

EXPERIMENT.

56. Two drachms of crude mercury were injected by means of a proper apparatus into the crural vein of a dog. It produced no effects that were obvious for at least a whole day ; but afterwards there were evident marks of increased action in the vascular system, attended with a quick and hard pulse. After he had continued in this state two or three days, a dyspnœa supervened ; this was soon followed by a cough, and symptoms evidently denoting an affection of the lungs, which daily increased until he died. His lungs, on examination, were found in a tubercular state ; many of these tubercles had suppurated and formed vomicæ.

57. The question here is, whether these tubercles and vomicæ arose from the introduction of the mercury.

The answer is very clear. The animal was in

perfect health before. This is only a presumptive evidence. But a minute examination of the tubercles put the matter out of doubt; for on making sections into the substance of them, each contained a globule of mercury, forming a kind of nucleus to the circumscribed inflammation or tubercle. Whether these mercurial globules acted on the principle of simple stimuli, or in a specifick way, is not a subject for our present investigation: but the inference intended to be drawn is, that symptoms of general excitement may exist in the whole body, and that only a particular organ may show marks of disease; and further, that the circulation may be accelerated through the whole vascular system of a particular organ, while only particular parts of that organ suffer a visible alteration in their structure.

58. Now it is natural to refer these appearances to some local cause, but which is not always so evident as in the experiment just recited. This cause may consist in local alterations in the tone of the vessels in the particular parts of an organ; and that, in consequence of an accelerated circulation through its whole substance, these debilitated parts may readily fall into a state of chronick inflammation.

59. In considering the active and indolent inflammations of the liver, we have referred the former to the hepatick artery or nutrient vessel; while the

latter has been considered as an affection of its secretory vessel. As this opinion is not taken upon the ground of mere conjecture, it will not be out of place to assign a reason for having adopted it.

60. When we state that chronick inflammations of the liver appear to be connected with its secretory office, we do not mean to rest the explanation on any thing specifick in its secretory energy, but on its peculiarity of having the secretion effected from venous blood instead of arterial.

61. It is a fact well established in physiology, that the living power or energy of any organ is, *ceteris paribus*, in proportion to the quantity of arterial blood that circulates through it. There is something then in the condition of arterial blood that fits an organ for active and vigourous purposes ; the proofs of this position are so numerous, that they need occur to every one. Now when we recollect that by far the greater portion of blood that passes through the liver is of the venous kind, and when it is remembered likewise that this blood is less fitted to active purposes than arterial, there will appear sufficient grounds for believing that chronick inflammations of the liver are to be referred to the venae portae ; while those of the active kind are imputable to the hepatic artery.

62. In the active and acute inflammation of the

liver, as well as that of other organs, the antiphlogistick practice should be adopted ; and as the attention of the practitioner should be directed to the prevention of suppuration, he must be guided by the circumstances of each individual case in forming his judgment to what extent that practice may be pursued. Here much depends on his discernment, as well respecting the extent of the antiphlogistick practice, as in determining the precise period when it is likely to be most useful : for it must be obvious, that if any considerable advantage is to be expected from this practice, it must be looked for in an early stage of the disease, when the inflammation has not advanced beyond the probability of resolution.

63. The more prominent part of the antiphlogistick treatment is blood-letting : the quantity of blood to be taken away, together with the propriety of repeating that operation, can be judged of only by the violence of symptoms, by the effect upon the pulse, and by the circumstances of each individual case.

64. Blisters, applied to the region of the liver, co-operate very strongly with the views of blood-letting, and therefore, in attempting resolution, recourse should be had to them very early ; and here again the same discrimination is necessary with respect to their duration and repetition, as was required

in the case of blood-letting. It has been advanced by some, and experiment appears to have justified the position, that a quick succession of blisters to the vicinity of an inflamed organ prevails more over the activity of inflammation, than the long protracted discharges from a single vesication. My own experience having abundantly confirmed the truth of this doctrine, I cannot recommend it to the practitioner in too strong terms.

65. As subservient to the intention of resolution, medicines promoting alvine evacuations are highly expedient ; for this purpose, those which are of a saline nature appear to me to claim a preference, and perhaps it is by adding not a little to their efficacy to exhibit them in a diluted form, in which state they not only seem to be more strictly antiphlogistick, but are less liable to occasion nausea and other disagreeable sensations in the stomach.

66. In blood-letting, blisters, and laxative medicines appear to consist the more essential parts of antiphlogistick practice ; but there are other resources of which we can avail ourselves, and which, though subordinate in point of activity, are found from practice to be very efficacious as auxiliaries. Under this head we may rank antimonials exhibited in such doses as may tend to produce and continue a degree of softness and moisture upon the skin ; and this op-

eration of antimonials is much aided by a free and plentiful use of diluting liquors, of which there is an endless variety.

67. By the means above recited, the practitioner, if called in at the commencement of the disease, will generally be able to check every tendency to the suppurative process.

68. In warm climates, more especially in the East-Indies, where hepatitis may be regarded as the endemia of the country, the tendency to run on into the suppuratory process is so great as scarcely to be resisted even by the most active practice ; therefore, if an early and vigorous pursuit of the antiphlogistic plan of treatment be necessary in this country, where the course of the disease is comparatively moderate ; the extension of such treatment to the utmost limits of prudence, becomes expedient, if we would oppose with success the rapidity of its progress.

69. If either from an unusual violence of the disease, the too late application for medicinal assistance, or the unavailing efforts of the antiphlogistic plan of treatment the inflammation shall have proceeded to the suppurative stage different phænomena occur, according to the particular part of the liver in which the suppuration is seated. These phænomena are such as arise out of the laws which regulate the

opening of abscesses : for the operation of nature in this respect, as well as in most others, is regular and uniform

70. From observation we learn, that hepatic abscesses sometimes open spontaneously into the intestinal canal in the manner explained, at some length, in a former part of this work ; at others, they make their way through the diaphragm into the air cells of the lungs, from whence the matter is discharged by expectoration ; or an adhesion takes place between the anterior surface of the liver and the parietes of the abdomen, allowing the pus to make its escape by the common integuments.

71. Each of these channels of discharge is determined very much by the particular seat of the abscesses. When the posterior or concave surface is concerned, the matter usually passes off by some part of the intestinal canal, frequently the duodenum ; but when it is seated towards the inferior edge, the colon offers a ready outlet. When the superior portion suppurates, the air cells of the lungs favour the escape ; and such abscesses as form towards the anterior surface, usually extend themselves to the integuments, through which they either discharge their contents spontaneously, or by the aid of surgical means.

72. The intention of nature in relieving herself

by these different channels is the same, as she is guided by one common principle in each of them, viz. that of availing herself of the nearest outlet. But experience has evinced that these are not all equally favourable to her ultimate views; and some hepatick abscesses, which have been discharged by the lungs, appear to have produced their fatal effects more from an extension of such abscesses into the substance of these organs, than from any derangement the constitution had sustained from the affection of the liver. I feel myself warranted the more in maintaining this idea, not only from having repeatedly seen the symptoms of hepatitis, in its latter stage, evidently transformed into the characters of peripneumony; but from having ascertained, by examination after death, that a suppurating surface, which originated in the liver, extended itself into the substance of the lungs in such degree, as clearly to explain the cause of the peripneumonick symptoms.

73. The discharge of hepatick abscesses, either by the intestines or the abdominal surface, is much preferable, as in the former, the organ, though important and even vital, is affected only to a small extent; and in the latter, very little danger can arise from an opening of a moderate size. What occasions our surprise is, that they so seldom effuse their contents into the cavity of the abdomen. The

law itself is wonderful, though the means by which nature carries her intentions into effect are very obvious ; for in all these cases the opening is surrounded by adhesions so effectually, that there is little danger of the general cavity being exposed.

74. If, however, the disease is well marked, and the abscess has pointed to a determined part of the integuments, we need not wait for a spontaneous opening, but by means of a lancet may discharge the matter. Such abscesses are seldom in haste to heal, nor is it desirable, until the cavity of the abscess shall have been filled up by healthy granulations. During this process, which is sometimes tedious, the health gradually returns ; and I have had experience of cases where the discharge accompanying this granulating operation was continued for years, during which time the health was in a progressive state of amendment, and at length was perfectly established.

75. Such instances, though surprising, are not mysterious, for a part only of the liver has been concerned in the abscess. During the period of active inflammation, the constitution partook of the effects, perhaps more from a principle of sympathy with the inflamed organ, than from any derangement in its economy as a gland ; and therefore it is natural to expect, that, as the inflammatory symptoms subside, the signs of health should return.

76. An opinion has for some time prevailed, that mercury is a specifick in every disease of the liver ; and that even in active phlegmonous inflammations it will obviate suppuration. This opinion appears to have been founded on an idea, that there is something very peculiar in the inflammation of the liver that is not met with in any other organ.

77. It is true, that in considering its glandular office, it affords an exception to the law of glands, in having its secretion performed from venous blood ; and this we have already considered as having a connexion with chronick inflammation, which experience has shown to be relieveable by mercurv. The success in these cases has perhaps led to an empirical practice, and due discrimination may not always have been made between inflammations of a more indolent, and such as are of a more active nature.

78. To exhibit a remedy without due discrimination is to abuse it, and at length to bring it into neglect ; and in this way the world has been deprived, for a time, of the benefit of some of the most valuable articles of the *materia medica*, which, however have been restored to them afterwards, on the recommendation of men of candour and ability, after having determined their true value by repeated and judicious exhibition.

79. Perhaps the same fate may await the use of

mercury in complaints of the liver, if by a blind-empirical administration of it, it be incautiously employed in the active periods of inflammation, when, from its stimulant properties, it appears better calculated to accelerate than to retard the suppurative process.

80. It is very probable, that the attachment of the practitioners in warm climates to the early use of mercury, may have arisen in part from the great debility consequent on the previous excitement of the system, which debility is supposed to prevail the most, where there had been much evacuation ; and this prejudice has perhaps been carried to a dangerous extreme. But there are not wanting some, who are perfectly aware of the necessity of proper distinctions, and who pay due regard to them in their practice.

81. In the East-Indies, where this complaint is endemick, I am informed, on the best authority, that many judicious and successful practitioners seldom administer mercury until the violence of the inflammatory action has been moderated by bleeding, active purging, and the antiphlogistick plan of treatment. Then it is, that mercury is employed to the greatest advantage. But it appears, on attentive observation, that the transition of active inflammation into a state of resolution, is not immediately

followed by a healthy condition of the part, but it remains for a time debilitated and disposed to lapse into a chronick state. This will probably be found the proper period for the exhibition of mercury, which acts as a spur on the vascular system of this organ, and by its moderately stimulating effects, occasions a degree of action, which, when protracted to a proper length, terminates in health.

82. But the disposition of hepatitis to terminate in a schirrous and diseased structure, either of the whole, or of a part of the liver, is so strong in some cases, as not to be resisted by a moderate mercurial action. Here we are to take the advantage of its more active operations ; and instead of inducing a slight change upon the pulse, with only a tenderness of the mouth, we ought to extend its effects to the production of a gentle salivation, which, when continued for a length of time, generally effects a cure.

83. In the exhibition of mercury for this purpose, a preference has been given to friction ; and the part on which the mercurial ointment has been rubbed, is the right hypochondrium, from a notion of its efficacy being greater when applied to the vicinity of the diseased organ, than to a distant part. But my opinion is, that there is no material advantage derived from this ; and it is of little importance,

what part is made choice of, provided the effects produced on the general system are equally strong.

84. The knowledge we derive from anatomy of the structure, origin, and direction of the lymphatick vessels, sufficiently proves, that neither by the internal use of mercury, nor by its external application, can any of it be made to pass through the liver in its way into the constitution ; it cannot, therefore, act on the liver but by being first introduced into the bloo' vessels. It is sometimes difficult in cases of diseased liver, especially if attended with dropsy, to introduce mercury into the constitution ; under such circumstances, the best absorbing surface should be employed for the purpose of friction : such parts of the body as have the finest cuticle, as between the fingers, in the axilla, or groin, absorb most readily, and if the cuticle be removed by blisters, from any part of the body, such a surface will be found best adapted to the purpose of absorption. Ulcers frequently absorb better than entire surfaces, and in many cases such artificial means of promoting absorption may be admitted.—It is likewise a subject worth considering, whether still greater advantage can be derived from the introduction of active and chymical preparations of mercury by absorption than by the use of the common mercurial ointment. — Ulcerated surfaces will absorb the saline

preparations of mercury, while a surface, covered with a cuticle, would, with difficulty, admit them. The quantity of mercury, at any one time, in a state of action in the body, is so small as to elude all the powers of chymical inquiry. By various and accurate tests, I have not discovered in the secretions any mercury in persons under a salivation, either from the internal or external use of it.

85. The schirrocity, which we have been considering as the remains of hepatitis, is often very intimately connected with other diseases; and is thought by men of observation and experience, to stand in relation to them, as a cause — Thus in India, the fever and dysentery, which are considered as the endemiae of the country, have been found, on dissection, to be accompanied with diseases of the liver. In some instances, the whole substance has been in a schirrous state; in others, abscesses and the usual appearances of hepatitis have been met with: the fact is certain, though the relation in which they are placed to each other may be matter of opinion.

86. If it be true, and there can be but little room for doubt, that every disease of a gland must affect, in some degree or other, its secretory powers, we may admit, that the biliary secretion may become extremely vitiated, may acquire acrid properties, and may morbidly affect the intestinal canal by

its passage through it ; hence may follow ulcerations of the internal surface, giving rise to the common symptoms of dysentery. But if it be an established fact, as has been asserted by high authority, that the dysentery is always contagious ; there would seem to be a necessity for calling in some other principle of action, in addition to the acrimony of the bile. But waving this controversy, which cannot be protracted to a greater length, without evidently digressing from the main purpose of this chapter, it is in place here to observe, that these dysenteries are so far congenial to the hepatick affections with which they are combined, that they are generally relieved by mercury administered under the cautions we have already laid down.

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